Vertical coordination and integration, market power and price transmission in the value chain of the South African macadamia industry

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Thesis submitted in fulfilment of the requirements for the degree Doctor of Philosophy in Agricultural Economics at the North-West University

Promoter: Dr DC Spies

Graduation May 2018
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DECLARATION:

I declare that the thesis hereby submitted by me for the PhD degree in Agricultural Economics at the North West University is my own independent work and has not previously been submitted by me at another university.

SV Sheepers ___________________________  Date _______________________
As if yesterday, I remember the emotional reprimand my mother bestowed on me during my least inspiring school results achieved in 1973. Her stern words decisively changed the course of my life and thankfully inspired me towards my love for knowledge. It is to her memory that I want to dedicate this thesis.

To study and complete this thesis was made possible through the grace of God and the support and sacrifice of my family. I thank God for his ever presence during and blessing of this study from start to completion. I want to thank my wife, Liesl, for her support, motivation and patience during all the lonely hours she had to endure over the last three years. Thank you to my son, Jaco, and daughter, Chane, for the privilege of being fellow students at the NWU.

My foremost appreciation goes to my study leader, Dr David Spies, for his patience, persistent scientific rigour, and skilful guidance, shown during the execution of this study. I owe him my utmost gratitude for his assistance in making this thesis a reality.

Finally, I would like thank Andrea Saayman, Allen Duncan, Nico van Schalkwyk, Frans Stander and Francois Schlebusch for their assistance and support throughout this study.
The global tree nut basket consists of nine main nut types, of which the production is mainly located in North America, the Middle East, Asia and Africa. The “big five” of the nut basket consist of almonds, pistachios, cashews, walnuts and hazelnuts. Combined, the “big five” nut types make up 95% of the volume of global tree nut production. The “small four” – pecans, macadamias, Brazil, and pine nuts – make up the remaining 5% volume of tree nut production, with macadamias being 1.2% of the total in 2013.

The global and South African macadamia industry is a young and emerging, and very lucrative, industry which started with commercial primary production activities, and with focused processing and marketing initiatives, in the mid-1940s and 1960s, respectively. Today, it finds itself in transition between the late introductory and early growth phase of the product lifecycle. Global macadamia production is concentrated in the hands of South Africa and Australia, which in 2014 jointly contributed 57% of global production. In 2014, South African macadamia cultivation was carried on approximately 17 000 hectares and contributed an estimated 27% of total global production. The South African industry consists of
approximately 450 producers delivering their product to any of the 17 existing processors/marketers (PMs) which process and market the nuts in either kernel or nut-in-shell (NIS) format. The processing and marketing sector of the value chain is concentrated in the hands of four dominant PMs which control 71% of the processing and marketing market.

Finding itself in the early phases of the product lifecycle, and thus industry development, the South African macadamia industry is typified by a dynamic and continuously changing value chain and market structures, which present the industry with the prominent challenges. The challenges include the understanding of how vertical integration and coordination in the buying side oligopsonistic and selling side oligopolistic macadamia market structure impacts on price transmission with regard to magnitude, speed, nature, and direction of price shocks amongst the macadamia value chain participants. To address these challenges, a firm and comprehensive understanding of the fundamental dynamics of the industry is required regarding (i) the value chain structure, (ii) challenges facing and limiting the efficient functioning of the industry, (iii) stakeholder awareness and their understanding of the dynamic forces at work within the industry, and (iv) aspects contributing to the guidance of decision making in the public and private sector domains.

Compiling an extensive outline of the macadamia industry and the environment it operates within will not provide sufficient information to facilitate the understanding of the fundamentals of the industry. To make any normative judgements regarding the performance of the macadamia industry, a comprehensive industry analysis is required. This study was undertaken through the use of value chain analysis, concentration ratio, and price transmission analysis, structured to achieve a thorough understanding of the macadamia industry and thus allow for normative performance measurement.

The analysis of the South African macadamia industry shows that the value chain is condensed and that the main actors in the value chain comprise the producers, PMs, and wholesaler/value adders (WVA). With high barriers to entry into primary production, expansion in production in terms of area and volumes predominantly originates from existing farmers expanding primary operations, while very little growth is contributed by new entrants into primary production. Key value chain activities of processing and marketing are performed by 17 PMs in highly specialised and technologically advanced facilities. These PMs operate in
a buying-side oligopsonistic and selling-side oligopolistic market structure, employing either a vertically coordinated or a vertically integrated business model. With the PMs being the leading parties within the value chain, it can be concluded that the value chain is PM driven and that the governance of the value chain is located at the PMs level.

This market concentration and related market power at PMs level of the macadamia value chain is a big concern for producers who suspect that imperfect competition in the processing and marketing sector allows PMs to abuse their market power by pricing in a manner that does not allow for price signals to pass unaffected up and down the value chain, and thus through asymmetric price transmission, they capture excessive welfare and profits for themselves. Market concentration, market power, and price transmission for the vertically integrated (VIM) and the vertically coordinated (VCM) business models were therefore investigated, respectively, by using time series data that applied specifically to each business model at producer and PMs levels. The following methodological approaches were applied:

i. The Concentration Ratio and Herfindahl-Hirschman Index were calculated to determine the extent of market concentration and thus the existence of market power at the processors/marketers link of the value chain.

ii. The Augmented Dickey-Fuller as well as Phillips and Perron stationarity tests, the Engle and Granger cointegration test, the Engle and Granger two-step error correction estimation model, and finally the Granger causation tests were performed to determine time series stationarity, cointegration, rate of discrepancy correction, and causality, respectively.

Asymmetric price transmission, specifically with regard to backward transmission of increased wholesaler prices to producers, was found in the case of PMs following the VCM, while symmetric price transmission was found in the case of PMs following the VIM. The error correction model shows that although the rate of discrepancy correction takes place within a one-year period in both the VCM and VIM, the VIM is superior in its ability to accommodate magnitude discrepancy corrections between the producer price and wholesaler prices. The causality test performed shows the existence of un-directional causality in both the VCM and VIM. There is thus basically no flow of information in the market, leaving the producer and wholesale prices without any influence on one another.
From this study, it is clear that macadamia PMs, owing to the emergence of market structures resulting from vertical coordination and integration, possess all the attributes required to exercise market power up and down the value chain. The market structures resulting from vertical coordination and integration, and which are conducive to market power abuse manifesting itself in the form of asymmetric price transmission, are totally neutralised, however, by supply and demand patterns, i.e. demand consistently exceeding supply, as well as by the business model followed by the firms operating at the value chain link where market power is located.

**Keywords:** South African macadamia value chain, Vertical coordination and integration, Market concentration, Market power, Price transmission
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<td>AD</td>
<td>Anno Domini</td>
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<td>ADF test</td>
<td>Augmented Dickey-Fuller Test</td>
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<td>AIC</td>
<td>Akaike information Criteria</td>
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<td>AMS</td>
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<td>APT</td>
<td>Asymmetric Price Transmission</td>
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<td>BC</td>
<td>Before Christ</td>
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<td>Commodity Chain Analysis</td>
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<td>CIRAD</td>
<td>Centre de Coopération Internationale en Recherche Agronomique pour le Développement</td>
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<td>CPI</td>
<td>Consumer Price Index</td>
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<td>ISO 9001</td>
<td>International Organization for Standardization</td>
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<tr>
<td>kg</td>
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<tr>
<td>KZN</td>
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<td>SCM</td>
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<td>Total Kernel Recovery</td>
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<td>US</td>
<td>United States</td>
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<td>Abbreviation</td>
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<td>USD</td>
<td>United States Dollar</td>
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<td>Unsound Kernel</td>
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<td>Vector Auto Regressive</td>
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<td>Value Chain Analysis</td>
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<td>Vertically Coordinated Model</td>
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<td>VMF</td>
<td>Vertical Market Failure</td>
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<td>World Economic Triangle</td>
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<td>Wet Separation Process</td>
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<td>WVA</td>
<td>Wholesaler/Value Adder</td>
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<td>ZAR</td>
<td>South African Rand</td>
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Chapter 1: Introduction

1.1 Introduction

The macadamia nut is a relative young and unknown nut in the world’s nut selection, forming a mere 1.2% of total global tree nut production. Macadamias, also known as the queen of nuts, is rapidly becoming popular with the consumer due to its taste and health attributes, to such an extent that global demand regularly exceeds global supply. Seventy-two per cent of global production is concentrated in the hands of Australia, South Africa, and the United States of America (USA). Ninety per cent of global macadamia production is exported to main consuming countries including China, Vietnam, USA, Japan, Germany and Canada (INC, 2013).

The South African macadamia industry is a reflection of the global macadamia industry and is typified by approximately 450 primary producers delivering their product to one or several of the 17 processor/marketers (PMs) active in the PM sector of the value chain (SAMAC, 2014). The South Africa PM sector is dominated by four large operators responsible for the processing and marketing of 71% of the South African crop. These four PMs thus hold the majority of market share for the processing and marketing of macadamia nuts to a rapidly developing, global wholesale, value adding and consumer market. This situation places the four dominating PMs in a powerful position of controlling primary producers from a buying side oligopsonistic market position, and wholesalers/value adders from a selling side oligopolistic market position (SAMAC, 2013).

An industry characterised by a market consisting of a few buyers and few sellers, high asset specificity and durability within the primary production and processing sector, and unreliable or uncertain supplies of raw product from primary production sources, as well as high frequencies of transactions, exhibits typical characteristics that contribute to vertical market failure (VMF). A vertical market fails when the transactions within it are too risky and the coordinating contracts designed to regulate these risks are too costly, complicated or impossible to write and administer (Stuckey & White, 1993). Escalating levels of uncertainty in markets displaying VMF are expected to prompt the integrator to implement more complex techniques of coordination and thus obtain more control over value chain functions. Value
chain participants who were originally bound through contractual agreement would, due to increased levels of uncertainty, opt to move away from contracts towards vertical integration (Stuckey & White, 1993). Vertical coordination becomes more common with increased levels of uncertainty. Vertical integration is not subjected to contract revision and deals with changing conditions as they unfold. Vertical coordination through contracting, however, requires the anticipation of, and related constant contract revision to provide for, changing conditions. Vertically integrated firms have the ability to adapt faster to changing conditions through the elimination of opportunistic-behaving value chain participants, and their integrated/concentrated top management is able to settle differences faster and plan around agreed goals and expectations, as well as sharing and having access to relevant information that facilitates the reaching of harmonious agreements (Martinez, 2002). VMF is thus the most important motivating factor for progressing from no market coordination through vertical coordination to vertical integration, with the purpose of reducing market “chaos”, risk and uncertainty by creating fewer, but more organised, market structures that contribute to more rational and predictable market behaviour (Stuckey & White, 1993).

Under imperfect market conditions, characterised by insufficient product and market knowledge, buyers and sellers may lack adequate knowledge with regard to the exact specifications, attributes and price of goods that they demand or supply. These information imbalances might force value chain participants into expensive searching and sorting activities in order to collect information on the value and properties of a product. These searching and sorting costs are alternatively known as transaction costs and also include all those costs related to coordinating and managing the value chain activities and governance structures between buyers and sellers (Martinez, 2002). Transaction cost economics acknowledges that the main aim and impact of vertical coordination and integration is to lower transaction costs (Williamson & Masten, 1999). Rather than let the consumer foot the costs related to product quality and feature evaluation at the point of product purchase, processors could evaluate product characteristics with less cost and more efficiently further upstream in the value chain (Martinez, 2002). Gaining control over transaction costs through vertical coordination/integration improves the competitiveness and thus market position of a business by leaving greater gains/profits to be distributed amongst value chain participants in the coordinated/integrated value chain.
The motive for the creation of market power through horizontal and vertical integration/coordination should, however, not be underestimated. Monopolistic power is a result of horizontal expansion (integration) by a business, and not the result of vertical integration which is motivated by efficiency (Grega, 2003). However, the perception that monopolistic profits could be gained without vertical integration would only be valid under conditions of substitutability of inputs (Grega, 2003). If a business is subjected to variable/unreliable availability of non-substitutable scarce inputs, vertical integration and more specifically backward integration might contribute to sustainable input inflow and resulting output outflow, creating market power as well as greater market share.

Agricultural commodity markets have become highly concentrated at each level and integrated across levels of the value chain. Because of this, the vertical price relationship has become more prominent in importance. Price transmission studies provide important insight as to how changes in one market are transmitted to another, thus reflecting the extent of market integration, as well which of the markets function efficiently (Rapsomanikis, Hallam & Conforti, 2003; 2004). Most agricultural food chain markets operate under imperfect conditions, causing incomplete price transmission between value chain participants. In imperfect markets, caused by conditions such as market power and oligopolistic behaviour, rational supply and demand forces alone do not set transaction prices and volumes as they do in other vertical market structures. The terms of transactions, especially price, are determined by the balance of power between buyers and sellers, a balance that is unpredictable and unstable and which might lead to asymmetric price transmission (APT) between value chain participants (Meyer & von Cramon-Taubadel, 2004).

The challenge is to determine and understand how vertical integration and coordination in the buying side oligopsonistic and selling side oligopolistic macadamia market structure impacts on price transmission with regard to magnitude, speed, nature, and direction of price shocks amongst the macadamia value chain participants. To obtain an understanding of price transmission in the macadamia value chain, it is important to firstly understand the underlying dynamics of the South African macadamia industry clearly.
1.2 Background and problem statement

The global, as well as the South African, macadamia industry is relatively young with a mere 69 and 55 years, respectively, of industry development between the first actual modern-times commercial plantings in 1946 (Hawaii) and 1960 (South Africa) and (Smartkitchen, 2014). Macadamia nuts are growing fast in popularity with value-adding businesses and consumers, resulting in global demand regularly exceeding global supply (INC, 2013).

Typical of an immature and developing industry, the global and South African macadamia industry exhibits fluid and rapidly changing national and international market structures, as the few role players in the industry value chain continually position themselves to secure and maintain a competitive position. These fast and continually changing national and international market structures contribute to VMF and serve as a key incentive for vertical coordination and integration, with the main purpose of improving market structure and stability and thus rational and predictable market behaviour. A better-organised market structure established through vertical coordination and integration not only creates market “order” but potentially also market power and greater market share (Stuckey & White, 1993).

The macadamia sector is not different from other agricultural food-chain markets and also functions under imperfect conditions assumed to cause incomplete price transmission between value chain participants. Primary producers suspect that imperfect competition in the processing and retailing subsectors allows for middlemen to abuse market power by pricing in a manner that does not allow for price signals to pass unaffected up and down the value chain, and thus through APT, capture excessive welfare and profits for themselves (Vavra & Goodwin, 2005).

South Africa, currently the largest producer and exporter of macadamias in the world, is pivotal for securing of the future of the global macadamia industry. In most global markets, South Africa’s image of good quality and consistent supply sets the benchmark for the global industry and it can position itself as global market leader (McConachie, 2008). To become the global industry leader in a young and developing value chain, it is important to steer development in the right direction by (i) understanding the value chain in detail, (ii) identifying the challenges the industry faces and which limits its efficient functioning, (iii) creating with
stakeholders the awareness and understanding of the dynamic forces at work within the industry that will assist them to position themselves better with regard to profitability and competitiveness within the industry value chain, and (iv) guiding decision making in the public and private sector domains (Spies, 2011).

1.3 Motivation

For the purpose of motivating the research objectives of this study, a short overview of the global and South African macadamia industry is required. However, to create detailed perspective and understanding of the global and South African macadamia industry, a comprehensive view of the industry as a whole will be provided in Chapters 3 and 4 of this study.

The global macadamia industry, unlike the majority of other historic and well-established food crop industries, is unique in its youthfulness, with the earliest record of macadamias being “discovered” in Australia during 1828 (Shigeura & Ooka, 1984). It was a full 54 years later when the planting of the first Australian commercial orchard took place in 1882. In 1881, macadamias were introduced to Hawaii and it was not until the 1920s that macadamia nut farming and production began to take off in Hawaii. In 1946, the first big Hawaiian commercial macadamia orchards were planted. It took 10 years for this commercial planting to generate a first crop in 1956 (Shigeura & Ooka, 1984).

In the 1960s, the Hawaiian growers, in cooperation with airlines servicing the Hawaiian route, started to promote macadamia nuts as an exotic snack on their flight routes all over the world. As the world became more interconnected and open to trade, the popularity of macadamia nuts as a snack took off (Smartkitchen, 2014). Commercial production of macadamias has since spread globally to many tropical and sub-tropical areas.

Serious South African interest in macadamias took off during the 1960s when the first orchards were planted in areas such as Duiwelskloof, Gravelotte, White River and the coastal and inland areas of KwaZulu-Natal and Eastern Cape (SAMAC, 2008). With the first trial commercial plantings taking place in the 1960s, the South African macadamia industry is even younger than the global industry. During the 1990s, South African commercial farmers
recognised the huge economic potential of the macadamia industry and started with regular and planned annual orchard expansion.

South African macadamia production is concentrated in Limpopo, Mpumalanga, KwaZulu-Natal and the Eastern Cape, which respectively produce 35%, 45%, 16% and 4% of all macadamias in South Africa. The macadamia industry is mainly export focused, with 98% of South Africa production being exported (SAMAC, 2014).

South African macadamias are marketed either as kernel or as nut in shell (NIS). South Africa, being the largest exporter of nuts, is now becoming a major player in the international kernel and NIS market. Kernel nuts are used either as snack nuts or as ingredients for candies, ice creams, confectionary and mueslis. The market for macadamias sold as NIS is mainly the snacking market, concentrated in South East Asia and specifically China and Vietnam.

Evident from its short commercial production and consumption history, is the fact that the global macadamia industry is still very young and immature regarding physical production and the formation of value chain structures. It is because of the immaturity of the industry and the related continual and rapidly changing international market environment that the engagement is required in (i) the processes of vertical value chain coordination and integration, (ii) market development, (iii) the creation of an internal and external communication system, and (iv) the establishment of a clear set of product quality standards.

Similar to the global industry, the South African macadamia industry confirmed during the 1999 International Macadamia Symposium held in South Africa that, owing to existing industry structures and conditions, a dire need existed for the engagement and development of the above-mentioned processes (Vidgen, 1999).

Of the approximately 450 primary producers, only a few produce substantial volumes. The majority of producers do not produce sufficient volumes to justify the time and expense involved in processing infrastructure and market development. The obvious parties to embark upon processing and marketing initiatives are the sufficiently large, horizontally integrated, individual producers or sufficiently large, horizontally coordinated groups of producers operating in a cooperative business structure. These are the value chain links where the critical mass exists to spread the cost of processing infrastructure and market development.
across the broadest possible spectrum of value chain participants (Kuilman, 2008). Because of this, the buying and selling power in a small market, like macadamias, is concentrated in the hands of a few large PMs, causing imperfect competition conditions. Ultimately, these few, large PMs end up controlling the market, because without them, the industry value chain will fail/collapse (Kuilman, 2010).

During interaction between small farmers and concentrated PMs, the latter are more likely to pass on to farmers down-stream output price decreases rather than down-stream output price increases. The general expectation is thus that the use of market power will result in either positive or negative APT. In an oligopoly/oligopsony, both positive and negative APT is possible, depending on market structure and market participant conduct (Vavra & Goodwin, 2005).

In an immature and developing value chain, as in the case of macadamias, which is exposed to continuous supply and demand chain changes, it is important to engineer its development correctly by assessing the development of the value chain for competitive fairness towards value chain participants and to alert stakeholders of unbalanced power relationships (Vavra & Goodwin, 2005).

To effectively assess the macadamia value chain, one needs to firstly map and secondly quantify the value chain in order to identify the value drivers, key success factors and challenges that significantly impact on its fairness and competitiveness, as well as its sustainability.

The value of this study and the approach followed can be used for different purposes. These include giving input to government policies to improve the environment the industry operates in, and input to value chain participants to identify weaknesses and opportunities to improve value chain linkages and improve the profitability of all industry participants. It may also allow the identification of industry inefficiencies that could be improved through policy, and collective industry or individual actions.
1.4 Objectives

The aims of this study are to firstly map, quantify and analyse the South African macadamia value chain, and secondly, to determine the extent of vertical integration and coordination within the value chain. A third aim is to identify concentration levels and thus the existence of market power created through vertical integration and coordination between the different value chain linkages. Lastly, this study aims to determine and understand how market power is impacting on the magnitude, speed, nature and direction of price transmission within the macadamia value chain.

To achieve the above objectives, the following will be addressed:

- An investigation of the structure, conduct and performance of the South African macadamia value chain by conducting a comprehensive industry analysis, focusing on the South African macadamia industry’s structure, institutional framework and governance structure on which it is founded. The industry analysis will also provide information about the value chain structure, the various value chain participants involved, price formation processes, and finally, the quantification of the value chain;

- An evaluation of the macadamia value chain for the possible existence of market concentration and market power between value chain participants through the use of various available techniques, including concentration ratios, as well as the Gini, Rosenbluth and the Herfindahl-Hirschman indices;

- Through the application of various, and the selection of the most appropriate, regression models for the purpose of price transmission analysis, determining and understanding how market power is impacting on the magnitude, speed, and direction of price transmission within the macadamia value chain;

- Compiling a comparative study to compare the impact of market power created through vertical coordination/integration on price transmission within the alternative macadamia value chain models as found in the South African macadamia value chain.
1.5 Outline of the Study

Chapter 2 comprises a literature review providing a theoretical background regarding alternative value chain analysis methodologies, concepts of vertical coordination and integration, incentives for vertical coordination and integration, price transmission along the agro-food chain, and the causes of asymmetric price transmission. Chapter 3 provides a comprehensive overview of both the global tree nut and macadamia nut industries. Chapter 4 sets out a comprehensive analysis of the structure, conduct and performance of the South African macadamia industry. In Chapter 5, the data used and econometric methodology applied, as well as the empirical results emanating from the market power and price transmission analysis procedure, is discussed. Chapter 6 concludes the study and provides recommendations to the industry.
Chapter 2 Literature Review

2.1 Introduction

This chapter sets out a literature review providing theoretical background on all concepts and theories relevant to this study. The literature review starts off with a review of the value chain concept and the importance of value chain analysis (VCA). This is followed by a review of the VCA methodologies suitable for analysing the South African macadamia value chain. Next, the concepts of vertical coordination and integration, as well as the motives for vertical coordination and integration, are reviewed. The final section of the literature review focuses on price transmission along the agri-food chain, asymmetric price transmission (APT) and the various types of asymmetry, the causes of APT, and finally, the implications of APT.

2.2 The value chain concept and the importance of Value Chain Analysis

The literature contains an entire selection of vague explanations with regard to the theorem relating to supply and value chains. Before continuing with the literature review pertaining to the theoretical background regarding any of the above listed concepts, it is important to create a clear distinction between the concepts of supply and value chains.

Supply Chain Management (SCM) developed during the 1980s as an integrating approach used to manage the flow of goods from suppliers to end users. SCM, over time, evolved to include a broad and integrated collection of supply chain processes. The term “supply chain” is used globally and encompasses all activities performed to produce and deliver a product, as either an intermediate or final product to be used by another producer along, or consumer at the end of, the supply chain (Feller, Shunk & Callarman, 2006). The main focus of SCM is on the costs and efficiency related to the supply and flow of intermediate and/or final goods and services from the different sources of origination to the final point of application.

A supply and value chain are essentially matching views of the integrating processes in a business coordinating the flow of products and services in one direction, and of value in the form of demand and cash flow in the opposite direction. Both chains can be superimposed over the same network of businesses processes that interact to provide goods and services.
Supply chains usually refer to the downstream flow of goods and services from the point of production to the customer. The customer is the source of the value, and value flows from the customer back to the supplier in the form of demand. Supply chains are focused upstream to integrate supplier and producer processes in order to improve efficiency, while value chains are focused downstream to create value in the mind of the customer (Feller et al., 2006). This distinct difference between a supply chain and value chain is often lost in the language used in research literature. In 1998, the Global Supply Chain Forum defined supply chain management as “the integration of key business processes from end user through original suppliers that provides products, services and information that add value for customers and other stakeholders”. This supply chain definition, now including the adding of value as part of supply chain processes, blurs the distinction between the concepts of supply chain and value chain (Feller et al., 2006).

Kaplinsky and Morris (2003), as well as Hobbs, Cooney and Fulton (2000), define the value chain as the full range of activities needed to bring a product or service from conception, through the different phases of production, to delivery to final consumer, and the final disposal after use. Value chains can thus be described as mechanisms that provide opportunity to producers, processors, buyers, sellers, and consumers, who all are removed by distance and time, to add value to products and services as it moves through the various value chain links (UNIDO, 2009a). The value chain definition formulated by Kaplinsky and Morris (2003) will be used as the point of reference during the VCA literature review section of this study.

According to Kaplinsky and Morris (2003), there are three distinct reasons why VCA is important. These reasons are:

i. With global dispersion of component production, organisational efficiency and competitiveness has become increasingly important. The need for organisational efficiency and competitiveness dictates that businesses should concentrate on those competencies which provide them with competitive advantage over their competitors. Marginal competencies should be outsourced to other firms in the value chain. VCA plays an important role in explaining and understanding the extent of the need for organisational
competitiveness. The identification of the businesses’ core capabilities will aid with the identification of those competencies in which they enjoys competitive advantage as well as guide the firms to outsource those functions in which they have marginal or no competitive advantage.

ii. The second reason why VCA is important can be attributed to the fact that it helps to understand why businesses and countries specialise in the production of specific goods and services, while avoid getting involved with others. VCA also provides insight into how the ability of producers to benefit from their participation in local and global markets is affected through the manner in which they are linked to their final markets.

As an example, in many cases wholesalers and retailers are quite happy for manufacturing firms to extend their value-adding element of production, but remain very resistant to these same manufacturers developing their competence towards market development and marketing of the product. Downstream buyers of the product see market development and marketing of the product as their domain for competitive advantage and income from the value chain.

iii. The third, and in the case of this study, the most important reason why VCA is important, lies in the fact that it explains the distribution of welfare benefits, particularly profits, to those participating in the value chain.

2.3 Methods available to analyse value chains

The concept of VCA originates from two definite lines of thought: the French ‘filière’ concept and Wallerstein’s concept of commodity chains. From both these approaches, various derivative methods for VCA, including well-known approaches such as Porter’s theory of the value chain, Gereffi’s Global Commodity Chain (GCC), and Humphrey’s world economic triangle (WET), have evolved over the years (Fabe, Grote & Winter, 2009). The concepts of GCC and WET were later merged together to create the global value chain (GVC) (Fabe et al., 2009).
Methods to analyse value chains can be grouped into two basic categories. The first category consists of methods with a predominant descriptive and qualitative focus, and the second group consists of methods utilising specialised applications with analytical characteristics (Kaplinsky & Morris, 2003). This section provides a historic synopsis about the evolution of VCA during the last few decades.

The filière concept was developed in the 1960s as a diagnostic tool for empirical agricultural research. The concept was used to formulate an improved understanding of how public policies, investments and institutions impact on local production and distribution systems of agricultural products (Tallec & Bockel, 2005). The system focuses on how local primary production units are connected and interact with the processing, export, wholesale, retail, and finally, the consumer levels located further downstream in the value chain (Van den Berg, 2009). The filière approach consists of a process quantitatively analysing the physical flow of inputs and outputs, related prices and value added to the intermediate product at each different stage by the various value chain participants as the intermediate product progresses down the value chain to obtain final product status (Tallec & Bockel, 2005). The application of the filière concept has been limited to domestic value chains, thus stopping at national boundaries (Kaplinsky & Morris, 2003). The filière analysis, however, is viewed as having a static character, limited to depicting chain relationships as a snapshot at a specific moment in time. It does not reflect the dynamic nature of expanding and declining flows of a product or information, nor the progress or deterioration of circumstances that value chain participants experience (Fabe et al., 2009).

In the 1970s, Wallerstein (1974) developed the concept of the commodity chain. A commodity chain is defined as a system of labour and production processes from which a finished commodity results (Hopkins & Wallerstein, 1986). The concept of a commodity chain serves as the base for the further-developed GCC by Gereffi. The main aim of the commodity chain approach is to explain the value chain activity distribution principles followed in capitalistic world economy. The commodity chain reflects a holistic approach and is macro-orientated (Gereffi, Humphrey & Sturgeon, 2005).

Shaffer (1973) introduced the concept of the sub-sector. A sub-sector is “an interdependent array of organisations, resources, laws and institutions involved in the production, processing
and distribution of an agricultural commodity” (Nang’ole, Mithöfer & Franzel, 2011). A sub-sector thus comprises a selection of chain activities, and vertically and horizontally linked chain participants, as well as the rules governing these activities and related participant interactions (Staatz, 1997). Sub-sector analysis (SSA) involves the studying of systems of relationships connecting producers, processors, distributors and merchants with the final consumers of goods and services (Nang’ole et al., 2011).

In the 1980s, Porter (1985) formulated the concept of VCA as a mechanism to determine the value of each step in the production process (Figure 2.1 below). The concept of VCA is utilised as a framework that businesses can use to detect their sources of competitive advantage. Porter (1985) argued that the sources of competitive advantage cannot be detected by looking at a firm as a whole, which should rather be “de constructed” into a series of activities. Porter categorised value chain activities either as primary or support activities. All chain activities associated with the production process are categorised as primary activities. All activities performed to contribute and ensure the effectiveness and efficiency of the business are categorised as support activities (UNIDO, 2009a). The objective of primary and support activities is to provide the customer with a product or service, the value of which is higher than the sum of the costs of all chain activities, and thus generate a profit margin (Roduner, 2004). Based on Porter’s approach, VCA is limited to the firm level, which results in the ignoring of the analysis of upstream and/or downstream activities outside the company’s operational boundaries (Fabe et al., 2009).
During the 1990s, Gereffi and others used Wallerstein’s commodity chain approach to develop the GCC. The central focus of GCC is to assess global trading systems and the sustained integration of global production and marketing chains (Tallec & Bockel, 2005). Gereffi et al. (2005) used the value chain framework to develop the GCC approach in order to examine the ways in which firms and countries are globally integrated and to investigate the determinants of global income distribution. Gereffi et al. (2005) established four core elements: (i) input-output structure, (ii) territorial (international) structure, (iii) institutional framework, and (iv) governance structure. Gereffi et al. (2005) state that commodity chains in most cases have a clearly identifiable leading party or parties who are responsible for the overall character of the chain. These leading parties usually, as a rule, takes responsibility for chain upgrading possibilities and knowledge transfer, as well as integration and coordination, within the value chain (Fabe et al., 2009). Last mentioned is the function of ‘governance’. A clear distinction can be made between two types of governance approaches. The first type of governance approach entails coordination initiated by the buyer, and is also known as a buyer-driven commodity chain. The second type of governance approach, in which the producer plays the key role, is known as a producer-driven commodity chain (Tallec & Bockel, 2005).

Founded on Gereffi’s GCC, the WET theory was created by Messner (2002). Messner’s theory is founded on the view that all the opportunities and actions available to GCC participating
clusters are determined by the chain participants and governance structures, as well as regulatory systems operational within the GCC.

Messner identified six crucial aspects in an economic triangle which comprise (i) value chain participant clusters, (ii) interests, (iii) authority structures, (iv) situational mindsets, (v) action orientation, and (vi) trust. This approach concentrates on the improvement of entire areas by integrating them into commodity chains. The WET thus follows a horizontal and vertical integrative approach by vertically integrating whole horizontally expanded areas/clusters into value chains (Roduner, 2004).

The GCC concept was further developed into the GVC approach, displaying an advanced view on chain governance (Gereffi et al. 2005). The global economy is increasingly structured around the GVCs that account for a rising share of international trade and employment. GVCs connect businesses, workers and consumers around the world and frequently provide a mechanism assisting firms and workers in developing countries to become part of the world economy.

The GVC structure provides perspective about how international businesses are structured by examining the composition and dynamics of the various value chain participants in a specific industry. In the current globalised economy with its extremely complicated interactions, the GVC approach is a convenient method for mapping the changing trends of global production, connecting geographically separated value chain activities and participants of a specific industry, and simultaneously verifying the tasks that they fulfil in young as well as mature economies. The GVC structure focuses on the organising of all value adding activities, including idea inception, product design, production, distribution, final application/use, and finally the discarding of the product remains. It scrutinises the product and processes with regard to job specifications, production technologies, quality standards and safety regulations applying to markets of specific industries in specific countries. GVC analysis thus provides a holistic analysis of global industries, from the primary producer to the final consumer, and vice versa (Gereffi & Fernandez-Stark, 2011).

The comprehensive nature of the GVC framework provides a method to explain the changed global–local dynamics that have developed during the past 20 years. The GVC framework has
gained importance in dealing with new industry phenomena such as: the role of emerging economies, with the likes of China and India acting as new drivers of GVCs; the importance of international product and process certifications as a prerequisite for competitive success by export-orientated economies; the pertinence of consumer-driven demand for workforce development initiatives towards continuous socio-economic upliftment; and the rapid increase in privately created production regulations and quality standards by dominant value chain participants such as international retailers (Mayer & Gereffi, 2010).

Figure 2.2 below illustrates the developmental order and inter-relationship between the various value chain analysis methodologies.

![Diagram: Developmental order and inter-relationship between value chain analysis methodologies]

**Figure 2.2: Developmental order and inter-relationship between value chain analysis methodologies**

*Source: Own representation*

The following sub-sections present a comprehensive review of the alternative analysis methodologies starting with SSA, followed by CCA, and VCA.
2.3.1 Sub-sector analysis

The SSA approach is known under several names and has been developed independently by analysts working in different countries and disciplines. Other frequently used terms for the SSA include channel mapping and the commodity systems approach (Staatz, 1997).

The SSA is a way of viewing a “vertical slice” within the food systems framework. Holtzman (2002) defines a sub-sector as a vertically connected series of production, transformation and marketing functions that shift an agricultural product from the farm through the value chain to consumers. During the transformation process, value is added as commodities progress through separate industries located across sub-sector stages.

SSA utilises the fundamental framework of structure, conduct and performance originating from the industrial organisation theory. The SSA approach thus examines how production and distribution activities for a commodity or closely related group of commodities in a sub-sector are organised (structure) within the economy. It investigates the productivity (performance) of those activities and how it can be increased, through either improved technology or better institutions and policies responsible for the coordination of the various stages of the production and distribution. It finally interrogates sub-sector participant behaviour (conduct) during interaction (Holtzman, 2002).

Holtzman (2002) regards SSA as a dynamic process that analyses how markets and businesses react to changes in conditions with regard to international supply and demand, technological developments, and new/adjusted management techniques.

Marion (1986) defines a sub-sector as “An interdependent array of organisations, resources, laws, and institutions involved in producing, processing and distributing an agricultural commodity”. A sub-sector can thus be viewed as a collection of value chain activities and chain participants, together with the rules regulating the actions performed within the sub-sector. The SSA approach has a strong institutional flavour due to the inclusion of the rules governing the chain activities.
According to Staatz (1997), the basic tasks involved in SSA include:

i. Describing the current structure of the SSA, in terms of the activities, actors, and rules involved in the chain.

ii. Explaining why and how this structure came into existence.

iii. Analysing the implications of this structure for economic performance of the sub-sector in terms of efficiency, equity, progressiveness, and other measures of performance that may be important to the individuals performing the analysis. This analysis should not only include the current performance but also the probable future performance of the sub-sector. Predictions about the future performance will take into account what the analyst knows about the evolving supply and demand conditions facing the sub-sector, for example the need to meet changing product quality standards that will have to be complied with in order to stay competitive in the export market.

iv. Analysing possible forces of change influencing the sub-sector and the implications thereof on sub-sector performance. These forces might include forces that would modify the supply and demand conditions on national and international levels, changes in government policies, institutions and technology.

SSA is guided by five key concepts (Staatz, 1997):

i. **Verticality.** This is a basic systems view that acknowledges that the conditions at one stage in the sub-sector are likely to be influenced by conditions in other stages in the vertical chain, sometimes in indirect and unexpected ways.

ii. **Effective Demand.** SSA views effective demand as the pump that pulls goods and services through the vertical system. The approach emphasises:

   a. Understanding the dynamics of how demand is changing at both domestic and international levels and the implications that those changes have on sub-sector organisation and performance. For example, more rigorous product specifications required to compete in export markets may signal a need to shift
away from trading on spot markets to more precisely specified contracts between producers and exporters.

b. Examining possible barriers limiting the flow of information with regard to changing demand patterns back to producers at different levels of the sub-sector. Price differences relating to product grades should reflect the importance that processors place on the different qualities of the raw products they use in the production process.

iii. **Coordination within Channels.** Much of SSA involves how well current markets, contracts, vertical integration, or other types of arrangements harmonise and coordinate the activities of different value chain participants within the sub-sector.

iv. **Competition between Channels.** A sub-sector may often involve more than one marketing channel. In agriculture, a proportion of a product may be destined for export, while the rest may be destined for the domestic or processing market. The two different channels may compete with each other for inputs or for clients in the output market. SSA attempts to understand the competition and examine how it might be modified to achieve improved economic performance.

v. **Leverage.** Where large numbers of small firms are involved, it may be very costly to develop institutional actions with the aim to help each firm individually. SSA attempts to identify key points in the production–marketing chain where actions could help a large number of firms at the same time. This often involves working with producers of a key input sold to a large number of firms or processors, and marketers of products requiring access to specialised infrastructure and markets.

The SSA approach is not suited for solving all the problems of an agricultural industry’s value chain linkages. It is for example, not suited to addressing issues such as financing that may cut across several sub-sectors. SSA is one way of beginning to understand how to improve coordination in order to improve the performance of the agricultural industry’s value chain (Staatz, 1997).
Holtzman (2002) drafted, in matrix format, a comprehensive checklist for ten key areas that must be considered when a SSA is performed. Using this comprehensive checklist when performing a sub-sector baseline study allows for the collection of available information into a systematic and integrated package. A thoroughly performed sub-sector baseline-study is invaluable as source of reference for all parties involved in, or related to, the value chain on which the SSA was performed (Holtzman, 2002).

Holtzman (2002) highlighted, with regard to agricultural products, commodity characteristics and consumption patterns as important areas of investigation. Commodity characteristics of agricultural products are important because of the perishable nature thereof, and the special care needed in terms of investment in sorting and grading equipment, specialised refrigeration facilities relating to storage and transport, and handling equipment essential to maintaining the cold chain and therefore the quality and freshness of the product. Consumption patterns receive special emphasis as an area of investigation because product demand acts as the value chain driver responsible for pulling the commodities through the subsystem. In addition to commodity characteristics and consumption patterns, other areas of sub-sector investigation include commodity supply and price relationships, food system participants, marketing structures and infrastructure, state marketing bodies and policies, and international trade and product competitiveness, as well as the time during the commodity production and marketing cycle at which the sub-sector study is performed.

After using Holtzman’s comprehensive checklist to perform a sub-sector baseline study, the structure, conduct, and performance framework as depicted in Figure 2.3 below can be used to analyse the integrated package of available information. In Figure 2.3, the structure (S), conduct (C) and performance (P) segments, or SCP characteristics, distinguish between industry- and sub-sector-specific attributes.

Market structure comprises inter-connected market characteristics, such as the number and strength of buyers and sellers in a market and the level of collusion among them, the extent of product differentiation, and ease of entry into and exit from markets, that all influence the level and form of competition among the value chain participants operating in the market. The main objective is to determine where, within the sub-system, market power is located. A handful of chain participants, mainly including dominant wholesalers, processors and/or
marketers of notable scale, can apply significant market power and thus control owing to the large proportion of a commodity’s flow passing through their hands.

By applying the SCP concept to SSA, one can observe the conduct of sub-sector participants through their efforts to transfer control, rewards and risks. The definite coordinating actions of sub-sector participants, the degree of collaboration or differences between stages, and the distribution and sharing of information across stages are central points of interest. It is important to consider the extent to which a sub-sector, overall, responds to changes relating to price and supply adjustments, variances in the global market conditions, and emerging competitors and competitive threats (which are all important aspects) when analysing conduct-related information collected through the Holtzman baseline study procedure. A comprehensive performance analysis at sub-sector level characteristically would include (Holtzman, 2002; UNIDO 2009a):

- The matching of supply and demand between chain levels.
- Assessing the steadiness of output, prices and profits.
- Measuring the technical and operational efficiency at each stage and linking stages.
- Determining the return of rewards relative to risks.
- Assessing the accuracy, sufficiency and impartiality of information.
- Determining the rank and type of employment.
- Assessing the flexibility and responsiveness of the sub-sector.
Figure 2.3: Structure, conduct, performance model as applied to the commodity sub-sector approach

Source: Marion (1976)
2.3.2 Commodity chain analysis or “approche filière”

The commodity chain approach and related commodity chain analysis (CCA) refer to the entire group of value chain participants and their related economic activities that directly contribute to the production of a finished product. The production sequence is comprised of a range of value chain activities which starts off with either the raw material or intermediate product, that after progressing through the transformation and value-add process, becomes available as a final and complete product ready for use by the consumer (Tallec & Bockel, 2005). Commodity chains thus serve as channels through which commercialised agricultural resources are guided from primary production level to the final consumer level at national and global scales. CCA is a useful methodology to apply when analysing how and for which chain participants these market channels function. It is an application that assists with the understanding of which chain participants benefit from resources, how they benefit, and how those distribution patterns of benefit might change over time (Ribot, 2005).

According to Ribot (2005), CCA is characterised by four distinctive features that can be outlined as follows:

i. CCA focuses empirically and theoretically on markets.

ii. CCA assesses the influence of power and the source it originates from, as well as the impact of its application on a socially differentiated environment.

iii. CCA recognises political institutions and politics as being integral to the existence and functioning of markets and pays attention to competitive as well as collective/collusive behaviour between value chain participants.

iv. CCA views governmental and non-governmental forms of regulation as an inseparable feature of markets.

CCA begins with the process of chain mapping with the main purpose of providing an outline of the chain, the commodity flow through the chain, and the chain participants involved in the chain, as well as the nature of the interactions taking place amongst the chain participants.
The process of commodity chain mapping involves five basic activities that comprise: (i) the determining of value chain activities and product flows amongst the various value chain participants in the commodity chain; (ii) the identification of value chain participants involved in the production, processing, trade, transportation, wholesale, retail and final consumption of the product being investigated in the chain; (iii) functional analysis; (iv) creating a flow diagram for the commodity chain; and (v) quantifying the physical flows (Tallec & Bockel, 2005).

Completing the five basic chain mapping activities as listed above enables the mapping of two commodity chains, one for the mechanisms, structure and processes at work in the chain, and the other for the welfare (profit) distribution between the individuals and groups participating in the value chain (Ribot, 2005).

Each of the five steps in commodity chain mapping will now be discussed briefly.

i. **The identification of actions and flows between the different agents in the commodity chain.** This process usually starts by identifying the main activity of agricultural production of a specific product, which provides the name of the commodity chain being examined. The commodity chain of the product can be followed either downstream, through the different levels of value chain activities to the final consumer, or upstream by identifying the suppliers of inputs and services which flow into production. When following the commodity chain downstream, the major problem encountered is the ability to precisely identify the sub-chains related to the different value-adding activities and to different products and by-products. Following the chain upstream also presents challenges to the analyst with regard the extent to which the analyst should include upstream activities of input provision into the transformation process taking place in the commodity chain. In general, only chain participants directly involved with the product during the transformation process should be included in the chain. In order for the analyst to make the above-mentioned upstream and downstream value chain participant differentiation decisions, he/she must fully understand the production techniques and related technical linkages involved in the commodity chain.
Identifying the agent. The word “agent” is used to describe an individual or business unit active in the economy who takes decisions independently. An agent could be an individual or a legal entity such as a business or a regulatory authority. Transfers of goods, services or funds amongst agents are referred to as “flows” (Ribot, 2005).

Numerous and different types of agents operate in various commodity chains within a national economy. These different types of agents can be classified according to the principle chain activity in which they are involved and can include primary production, harvesting, value adding, transportation, wholesaling, retailing and consumption (Tallec & Bockel, 2005).

A commodity chain thus provides for the total sequential description of all actors and related transformation and distribution activities involved in the process of ultimately giving value to a final product. An agricultural commodity chain would typically start with the inflow of production inputs and services into the farming production process, resulting in intermediary products serving as raw material/inputs for other downstream chain participants. The commodity chain from here on can possibly be split into various “sub-chains”, based on the different post-harvest applications and processes involved with the product (Tallec & Bockel, 2005).

The following elements and agents are likely to be observed in a standard agro-food chain:

- Input suppliers (seed, agricultural chemicals, equipment manufacturers, sales and research);
- On-farm crop and livestock production processes, which produce commodities to be used as intermediate products in downstream value-adding activities by other value chain participants;
- Processing and packaging industries;
- Transporting, wholesaling, and retail industries;
- Non-agricultural food chains;
- Financial and credit provision services;
- Research and extension services;
- The catering industry; and
consumers (Tallec & Bockel, 2005).

The essence of the main commodity chain, together with the related commodity flows resulting from aforementioned elements, influences the number of sub-chains emanating from the main commodity chain (Tallec & Bockel, 2005).

iii. **Functional analysis.** On completion of the identification of all value chain agents and their related activities, their interactions must be shown in a functional analysis table. A functional analysis table is comprised of: (a) a description of the stage of the chain analysed; (b) the dominant functions performed during each stage of the chain; (c) the different agents responsible for the execution of these functions; and (d) the products resulting from the chain processes, i.e. the primary product used as input and the alternative products resulting from the transformation process which the primary product has gone through (Tallec & Bockel, 2005).

iv. **Generating commodity chain flow diagram.** A commodity flow diagram can now be used to illustrate all the information assembled in the functional analysis table. Using a commodity flow diagram is an effective way of illustrating functional analysis information due to its visual display of the intricacies of all interactions and product flows between agents. The commodity flow diagram assists with creating perspective between the consecutive chain stages being examined, and thus prevents the overlooking of any section of the chain during the analysis process (Tallec & Bockel, 2005).

v. **Quantifying the physical flows.** Utilising the flow diagram depicting the characteristics of the flows amongst the various agents, a quantification of the identified flows must next take place. Quantification of the flows should be done in both physical and monetary terms. Quantifying the flows permits the analyst to determine the proportionate significance of the secondary chains stemming from the central chain, which subsequently will permit proper time allocation with regard to research (Tallec & Bockel, 2005).

Quantifying flows in monetary terms amounts to measuring profits and their distribution within the commodity chain of interest. To measure profits and the distribution thereof involves the methodical collection of purchasing and selling
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prices, as well as cost data, at every level of the commodity chain. Profit margins at each level of the value chain can be determined by calculating the product’s unit price and subtracting from it the unit cost. To form an idea of the average income generated by each value chain actor at a specific level of the value chain, the quantity of product produced at the specific level of the value chain must be multiplied by the price at each level and then divided by the number of actors within the specific value chain (Ribot, 2005).

Ribot (2005), however, added two additional commodity chain mapping activities to the five already listed by Tallec and Bockel (2005). The two chain mapping activities added by Ribot are a logical development from the fifth mapping activity, i.e. quantifying the physical flows as listed by Tallec and Bockel, and comprise: (i) evaluating the horizontal distribution of income and profit in the commodity chain, and (ii) mapping how access to the chain is maintained and controlled.

The two additional steps of commodity chain mapping added by Ribot (2005) will now be discussed briefly.

i. **Evaluating the horizontal distribution of income and profit in the commodity chain.** To estimate the distribution of profit at each level of the commodity chain is more complex than estimating the average profit. It requires the determination of market share that each actor controls at each level of the commodity chain. The total profit per actor can be determined by multiplying the volume of market share controlled by each actor by the profit margin made at a specific level/market of the commodity chain.

Comparing the distribution of income and profit between actors at a specific level, as well as at different levels of the commodity chain, provides a quantitative understanding of how skewed the distribution of income and profits might be. Skewed income and profit distribution amongst different actors within the commodity chain can be related to market power resulting from horizontal and vertical integration (Ribot, 2005).

ii. **Mapping how access to the chain is maintained and controlled.** Access to the value chain is acquired, maintained and controlled at different levels of the chain through an array of mechanisms. Mechanisms can include social ties, knowledge,
skills, licences and permits, quotas, contracts, collusion, and the creation of market power via various strategies, including horizontal and vertical integration. An analysis of margins and market share reveals the highly profitable chain links within the value chain and where the distribution of benefits/profits might be skewed. The objective of access mapping is to determine how and through what mechanisms these links of benefit concentration and exclusion are created and maintained.

Links of benefit concentration must be understood in their social and historical contexts. Links of benefit concentration are a function of mechanisms and politics of market channel control. Knowledge about how actors, involved at chain links associated with benefit concentration, came together and how they gained entry to a market while others were excluded, is important. Actors fortunate to be involved at a chain link with concentrated benefit might have gained access because they have capital, have family ties, know the right people, or are from the right ethnic, religious or language group. The factors or combinations of factors facilitating entry into chain links associated with concentrated benefit have a history and need to be explained (Ribot, 2005).

2.3.3 Value chain analysis

The value chain approach originates as far back as the 1960s when mining companies explored expansion opportunities and options (Kaplinsky & Morris, 2003). In 1957, the concept of VCA also appeared in agriculture when Davis and Goldberg (1957) created the term “agribusiness”. The authors used the term to describe the complete range of agricultural value chain activities such as the manufacturing and supply of production inputs, the actual on-farm production, the storage, processing, distribution and marketing of the final products. In the 1960s, the filière approach, as observed in French agriculture and applied to study contract farming and vertical coordination/integration, contributed to the development of the VCA approach (UNIDO, 2009). In its original format, the value chain approach concentrated only on primary production and commercialisation. During the 1980s, the value chain approach was expanded when the elements of transformation and value addition were incorporated into the approach.
The VCA approach became well known when Michael Porter established the concept in his book “Competitive Advantage: Creating and Sustaining Superior Performance” (Porter, 1985). This approach was used by Porter to determine the specific value added per individual value chain activity to the total value add of the product or service, once all value chain activities were performed.

The focus of Porter’s work was to enhance the competitive ability of a business, which is determined by three horizontal and two vertical forces of competition. The three horizontal competitive forces are (i) the risk of product substitution with alternative products, (ii) the risk of established competitors, and (iii) the risk of new competitors entering into a specific value chain level. The two vertical competitive forces are (i) the bargaining power of input providers, and (ii) the bargaining power of clients (UNIDO, 2009b).

Porter’s value chain approach emphasises that the competitiveness of a business, measured in terms of profitability, is dependent on how the different value chain activities that contribute value added to the product are managed. Porter conceived the term “margin” to describe the differential between the total value of a product or service and the total cost of all value-adding activities performed to create the final product. Total value of the product or services is represented by the price the client is prepared to pay for it (UNIDO, 2009). The business is only profitable when an adequate margin exists between the price the consumer is prepared to spend on the product or service and the total costs of value adding (UNIDO, 2009). The decision about which value chain activities should be undertaken by a business is directly related to the principle created by Porter, i.e. achieving competitive advantage (Ribot, 2005).

Following after Porter, several authors have contributed to the conceptualisation of the value chain approach by dividing it into various related approaches. A standard aspect among the different approaches to VCA is that the focus has moved from the individual business to the interconnected group of businesses within the value chain, which together add value to the product or service. The more recent approaches to the value chain concepts not only consider the main commodity, but also take into consideration the related by-products and further components of the final product which all are important to the competitiveness and sustainability of the chain (UNIDO, 2009).
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Figure 2.4 below provides a representation of the generic elements of a basic linear value chain map.

**Basic functions (chain links)**

<table>
<thead>
<tr>
<th>Provide</th>
<th>Grow</th>
<th>Grade</th>
<th>Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Inputs</td>
<td>Harvest</td>
<td>Process</td>
<td>Distribute</td>
</tr>
<tr>
<td>Dry, etc.</td>
<td>Pack</td>
<td>Sell</td>
<td></td>
</tr>
</tbody>
</table>

**Categories of chain operators and their relations**

- Specific input providers
- Primary producers
- Logistic centres, industry
- Traders
- Retailers

**Figure 2.4: General components of a fundamental linear value chain map**


There are various ways in which to analyse a value chain. Value chain analysis can be done with secondary research information originating from information sources, such as government or industry data and/or from primary information collected from industry participants through conducting interviews, questionnaires and market observations. Once the information is collected, various applications and procedures exist that can be used to interpret and derive conclusions from available data (Webber & Austin, 2004).
According to Webber and Austin (2004), as well as UNIDO (2009b), an in-depth VCA considers the following:

i. What are the main activities carried out in the value chain to manufacture the final product?

ii. Where does the product (service) originate from and where does it go?

iii. How does the value change through the value chain?

iv. At which value chain level does the product experience the greatest increase in value?

v. What are the economic costs along the value chain?

vi. What are the flows of products, information and knowledge in the value chain?

vii. What is the size (quantum) of the chain/sector in terms of production volumes, number of actors?

viii. What is the market share of the value chain?

ix. Who are the most important value chain participants in the value chain and what are their roles?

x. What types of relationships and linkages exist among the different chain actors?

xi. What possible synergies exist between vertically, as well as horizontally, linked value chain participants?

xii. Where are the bottlenecks in the value chain?

xiii. What are the institutional framework features of the value chain?

xiv. Are there market-related growth opportunities along the value chain?

xv. What are the main strengths and weaknesses of the chain?

xvi. Are there any opportunities for the improvement of the chain?

Large numbers of options exist which can be followed to analyse a value chain, subject to the value chain type and the argumentative line followed, as well as the goals of the analysis being undertaken. In order to avoid elaborate discussions about existing and often competing approaches to VCA, a generic approach based on commonalities between different approaches, and based on the following building blocks as reflected in Figure 2.5 below, can be designed (UNIDO, 2009a).
Based on Figure 2.5 above, the following order and procedure is recommended when doing a VCA. As a first step, a selection and prioritisation of the value chain to be analysed must take place. On identifying the value chain to be analysed, chain mapping must be performed to determine the transformation processes the product undergoes, as well as which value chain participants are involved at each level of the value chain. Mapping a value chain assists with gaining a clear understanding of the order of activities and the key actors and relationships involved in the value chain. This exercise is completed in qualitative and
quantitative terms through using flow diagrams and graphs presenting the various actors of the value chain, their linkages, and all operations of the chain, from input supply to primary producers, to final processing and marketing (UNIDO, 2009b).

After mapping the value chain, the next step is to analyse the market in which the chain operates, as well as the chain’s economic performance and competitiveness (UNIDO 2009a; UNIDO 2009b). Variables included in the economic analysis may include:

- Gross output values.
- Production costs.
- Margins.
- Price mark-ups.
- Physical flow of commodities along the chain.
- Destination of sales (international and international) along the value chain.
- Productive capacity and productivity.
- Measures of competitiveness.

The measured economic and competitiveness variables can be used to comprise a baseline when monitoring the potential impact of upgrading interventions in the value chain (UNIDO, 2009b).

Aspects that must be considered when performing the market analysis are shown in Table 2.1 below. These aspects of enquiry include commodity characteristics, demand and supply trends, price relationships and seasonality, food system participants and organisations, sub-sector and food system operation/behaviour, the marketing system infrastructure, government marketing institutions and policies, international trade and commodity competitiveness, and the representativeness of the term over which the study has been conducted (Kaplinsky, 2000). Analysis must also include an investigation of current and possible future markets, as well as the related standards to be achieved for the successful introduction of the product to the buyer (Webber & Austin, 2004; Ribot, 2005).
### Table 2.1: Data requirements for chain analysis

<table>
<thead>
<tr>
<th>Area of investigation</th>
<th>Data required</th>
</tr>
</thead>
</table>
| Commodity characteristic | • Grades and grading systems.  
  • Perishability.  
  • Physical handling requirements.  
  • Packing methods and materials for shipment and sale. |
| Consumption patterns | • Trends in the domestic and export markets.  
  • Consumption patterns by socioeconomic and ethnic group.  
  • Future market prospects. |
| Supply situation | • Production by region.  
  • Stocks for transformation and consumption by season and region.  
  • Flows between markets, including imports and exports. |
| Price relationship and seasonality | • Method of procurement.  
  • Secular trends in real prices at the farm gate, wholesale and retail levels.  
  • Seasonal and cyclical trends in prices.  
  • Changes over time in relative price relationships.  
  • Changes over time in input/output price and cost relationships. |
| Food system participants and organisation | • Marketing channels and commodity sub-sector stages.  
  • Important assembly, redistribution and terminal markets.  
  • Types, numbers, and geographical distribution of firms at key sub-sector stages.  
  • Prevalence and importance of alternative institutional arrangements, such as contracts, vertical integration, direct marketing, cooperatives, and spot markets. |
| Sub-sector and food system operation or behaviour | • Practices and strategies of sub-system participants (individuals, firms, organisations for procuring inputs, processing, storage and marketing of outputs).  
  • Vertical coordination mechanisms: exchange arrangements, risk-reduction/sharing, information dissemination.  
  • Sources, uses and distribution of production and marketing information.  
  • Adaptability and responsiveness of sub-system to shifting supply/demand, exogenous shocks, policy changes and uncertainty.  
  • Evidence of market power. |
| Marketing system infrastructure | • Physical infrastructure (transport, including roads, ports, airports and waterways; marketplaces; storage and processing facilities; communications; electricity; water supply).  
  • Infrastructure adequacy and bottlenecks.  
  • Evidence of excess or unutilised capacity. |
Area of investigation | Data required
--- | ---
Government marketing institutions and policies | • Regulatory environment: rules; input and product regulations; laws affecting marketing and trading activities; property rights.
• Public marketing institutions (parastatals, cooperatives, joint ventures); the extent and nature of their participation in marketing; effect on the behaviour and performance of private participants in the food system.
• Macroeconomic policies: price policies; exchange, interest, wage rate policies; fiscal and monetary policies.
• Banking and credit policies.

International trade and commodity competitiveness | • Commodity exports and world market situation.
• Imports of the commodity or substitutes and their impact on domestic production, markets and prices.
• Trends in exports and imports.
• Likely changes in exports and imports, and emerging market opportunities or dependencies.
• The competitiveness of exports in particular foreign markets.

Representativeness of the period under study | • Timing of the study relative to the annual commodity production and marketing cycle.
• Agricultural and economic characteristics of the year of the study relative to earlier years or climatic cycles.

Source: Kaplinsky (2000)

When performing the structural analysis of the chosen value chain, information regarding the governance structures, existing linkages, partnerships and networks must be collected. Supplementary information regarding environmental matters including cleaner production and sustainable use of natural resources, as well as potential methods for the reduction of negative environmental impacts, must be collected. Processing and analysing all the collected information will provide indications of possibilities for value chain development, innovation and upgrading. In combination with information about the broader influence of the value chain and its expected impact on employment, rent distribution amongst value chain participants, livelihoods and the environment, appropriate chain development and upgrading actions can be identified. Incorporating all these components of VCA ensures the use of a holistic approach that covers almost all aspects relating to the development of value chains (Webber & Austin, 2004; Ribot, 2005).
2.4 Concepts of vertical coordination and integration

Primitive agriculture was a fully integrated system. A single family would perform all the value chain activities of collecting seed, sowing and harvesting a crop, and raising and fattening animals, while consuming the surplus produce after making provision for seed and breeding stock for the next production cycle. In subsistence agriculture, vertical integration is nearly complete since most of the production resources and production decisions are held in the same hands (Penn, 1958).

The development from subsistence farming to the present market-orientated agricultural system has been characterised by the gradual disintegration of value chain functions. This disintegration process led to specialisation in a specific value chain activity. This is one of the distinguishing features of present commercialised agriculture (Rehber, 2007).

Agriculture is an industry involved in producing, transforming, transporting and marketing food and fibres to the consumer. To enable agricultural production, the agricultural industry is served by a large number of upstream industries providing farm inputs. Vertical coordination or integration between farms and other firms in the industry, both forward and backward, are inevitable and comprise one of the critical factors influencing market structure and competitiveness of agriculture (Rehber, 2007). As in the case of primitive agriculture, modern advanced agriculture is showing a strong tendency of moving away from disintegration back to vertical coordination and integration. Integration involves the process of merging two or more value chain activities together, under the control of a single value chain participant. The different actors in agricultural supply chains are thus abandoning their traditional competitive positions towards each other in favour of cooperation to increase efficiency as well as create market power with the aim of competing more effectively (Rehber, 2000).

The terms ‘vertical coordination’, ‘vertical integration’ and ‘contract production’ are often used interchangeably (Cramer & Jensen, 2000). Vertical coordination is rather a broad term which includes all methods of harmonising vertically interdependent production and marketing activities, ranging from spot markets through various types of contracts, to complete integration (Rehber, 2000).
In agriculture, four types or stages of vertical coordination exist between farmers and upstream and downstream businesses (Figure 2.6 below). Methods of vertical coordination can be classified according to the level of control over vertical stages (Martinez & Reed, 1996).

<table>
<thead>
<tr>
<th>Degree of Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
</tr>
<tr>
<td>Open production</td>
</tr>
<tr>
<td>Contracting</td>
</tr>
<tr>
<td>Quasi-vertical Integration</td>
</tr>
<tr>
<td>Maximum</td>
</tr>
<tr>
<td>Vertical Integration</td>
</tr>
</tbody>
</table>

**Figure 2.6: Methods of vertical coordination according to the degree of control over individual market stages**

Source: Martinez & Reed (1996)

The different methods of vertical coordination will now be discussed briefly.

i. **Spot or open market transactions.** In spot or open market transactions, farmers buy inputs from whomever they prefer and sell their products to whoever will pay the best price for them. In this type of relationship, no written or verbal contract exists between the two businesses interacting within the supply chain. This type of integration provides flexibility to farmers but holds the drawback of price uncertainties with regard to both the buying of inputs and selling of produce (Rehber, 2007). In an open/free market, system market mechanisms are controlled by price signals moving up and down the value chain. The message conveyed in the price would be passed back up the value chain from the final suppliers to the processors, to the farmers, and finally to the suppliers of input
items. Depending on market structures, this signal may be relayed at different speeds, magnitudes and direction between the different links in the value chain.

ii. **Contract farming.** Contract farming is sometimes also referred to as quasi-integration. British and American economists have different perceptions about whether contract farming can be viewed as vertical coordination or vertical integration. British literature clearly distinguishes between contract farming and vertical integration. It views the one as a substitute for the other and limits the meaning of vertical integration to what is referred to as “ownership integration” (Barker, 1972). American literature, on the other hand, regards contract farming as a form of vertical integration and does not view the ownership of assets across value chain links as a qualifying criterion for vertical integration (Allen, 1972).

Contract farming entails having relationships between growers and private or state enterprises that replace spot-market transactions between commercial farms and a processing, export or buying entity. A standard farming contract regulates, in advance, prices, production practices, product quality, and credit facilities. A classic definition of contract farming refers “to contractual arrangements between farmers and other firms, whether oral or written, specifying one or more conditions of production and marketing of agricultural product” (Roy, 1963.)

iii. **Quasi-vertical integration.** This type of coordination occurs when a business owns a specific asset that is used by one of its suppliers of intermediary inputs into its production process.

iv. **Vertical integration.** In this type of coordination, each successive production unit in the value chain loses its identity and original ownership, and becomes part of a larger merged/integrated production unit under new ownership. The now larger merged/integrated production unit owns the asset and improvements and employs its own labour force. A business can be described as vertically integrated if it consists of two successive single-output production processes in which the entire output of the first process is used partly (partial vertical integration) or
wholly (full vertical integration) as an intermediate input into a second process (Rehber, 2007). Riordan (1990) describes vertical integration as the organisation of successive production processes within a single firm producing goods and services. Vertical integration thus brings upstream and downstream assets and production under unified ownership and control.

However, according to Rehber (2000) and Martinez (2002), a fifth method of vertical integration exists within the agricultural environment, i.e. farmer cooperatives.

v. **Farmer Cooperatives.** Agricultural cooperatives are organisations usually integrated, owned, and controlled by agricultural producers, which operate for the joint welfare of its members (Rehber, 2000). Organising certain value chain activities under an agricultural cooperative structure can be seen as a form of ownership integration (Martinez, 2002).

Farmer participation in cooperatives provides members with better control over their destiny because cooperatives provide members easy access to markets, improve net returns and offset the monopsony power of processors (a market form with only one buyer of a product from several producers) by elevating prices in the market to competitive levels for all farmers, including those outside the cooperative organisation (Petraglia & Rogers, 1992). Because producers in a cooperative structure are the suppliers of raw material, while also being the owners of the processing plants, it might be incorrectly assumed that the relationships between farmers and processors are harmonious and without any problems. In reality, coordination through the cooperative approach can cause conflicts and disputes, especially when decisions about alternatively available marketing opportunities have to be taken. These problems can be avoided by establishing a contractual relationship between the producers and cooperative processor. To secure power at the bargaining table when producers and management negotiate about the setting of the terms and conditions contained in the contractual relationships, producers could organise themselves into bargaining committees to represent them as a group when setting the terms and
conditions of contractual relationships (Rehber, 2007). Farmer cooperatives are a balancing power and a contributing force for improving the level of competition in most agricultural commodity markets.

Thus, with vertical integration, contractual and market exchanges are eliminated and replaced with internal exchanges within the boundaries of the business. Two definite opinions exist with regard to asset ownership during the process of vertical integration. Grossman and Hart (1984) argue that vertical integration entails that the ownership of all assets involved in the transformation process exists across two or more successive value chain links. Vertical integration thus represents the complete control through ownership over assets used during the transformation process taking place within the value chain. On the other hand, Williamson (1967) views vertical integration as a shift away from owning the assets within the value chain used to produce goods and services, to the renting/leasing of assets (buildings, equipment and machinery) necessary for production. Williamson’s approach is not sufficient to define vertical integration. Vertical integration is the total control over the entire integrated production and distribution process, rather than just the control over any distinct input into that process (Rehber, 2007).

**Vertical integration** may display itself in several ways. Forward vertical integration occurs when a firm expands the scope of its activities to the production and distribution of a final product. Backward integration occurs when a firm integrates into the production of materials used in the production of the final product. **Vertical formation** can be defined as vertical integration which occurs at the time the firm is established. **Vertical expansion** entails vertical integration which takes place as a result of internal growth of the business by it creating its own subsidiaries of neighbouring value chain stages. **Vertical merger** can be defined as vertical integration which ensues when one business in the value chain is acquired by another business in a neighbouring stage of the same value chain (Rehber, 2007; Riordan, 2005).

According to Rehber (2007), integration is not limited to vertical integration but can also take other forms which include horizontal and circular integration. Horizontal integration occurs when a business gains control over another business performing similar activities at the same level in the value chain. When vertical and horizontal integration happens simultaneously, the integration process is called circular integration.
2.5 Motives for vertical coordination and integration

Vertical integration within the agricultural and food sector is one of the significant factors influencing market structure and the competitiveness of agriculture. Essentially, there are three groups of motives for vertical integration. The first motive originates from the effort to increase efficiency through the minimisation of costs, and the second from the effort to create market power. Market power is not purely the result of horizontal expansion, but also one of control over fixed proportions of non-substitutable key inputs obtained and secured through vertical integration (Grega, 2003). Motives specific to the agro-food chain make up the third group of motives for vertical coordination and integration within the agricultural and food sector.

2.5.1 Efficiency motive

The farm-to-consumer food system normally operating in an open market system relies on the direct and unchanged transmission of price signals through the different links in the value chain. Due to considerable close cooperation and coordination within the food system, it has over time moved away from open market transactions towards increased levels of vertical coordination, and ultimately, pure vertical integration (Rehber, 2000).

In order to explain alternative motives for vertical coordination and integration, one must accept the existence of vertical market failure (VMF).

Under perfect market conditions, coordination through spot markets has the capacity to coordinate the objectives of consumers, efficiently channel expensive and scarce resources to the point of production, and guide businesses to produce the appropriate products. Resource allocation under perfect market conditions will be efficient, subject to the following assumptions:

i. Every producer has perfect knowledge regarding product prices and production technology, and is able to maximise profits.

ii. All consumers have perfect knowledge of product prices and preferences, and maximise consumption utility with a specified income.
iii. Supply and demand equilibrium is established through price adjustment (Martinez, 2002).

Given that the aforementioned assumptions are met under perfect market conditions, prices will operate to allocate resources to the point of most efficient utilisation, while ensuring that consumer needs are fully met with available resources and technology (Martinez, 2002).

Under imperfect market conditions, businesses are concerned about their ability to buy and sell the required volume of product at specific prices. Buyers and sellers may have insufficient knowledge about the exact specifications of goods that they demand or supply. Due to insufficient product knowledge and information, buyers incur costs associated with the searching process for suitable suppliers offering the best prices, and sellers incur costs related to advertising the availability of products and its specific qualities. These costs are known as transaction costs and include all those costs related to coordinating and managing the value chain activities and governance structures between buyers and sellers (Martinez, 2002). Transaction costs are thus costs related to the negotiating, writing, executing and enforcing of governance structures, generally taking the form of contracts (Rehber, 2000). Transaction costs have been compared to “the costs of running the economic system” (Williamson & Masten, 1999).

Transaction cost economics (TCE) analysis acknowledges that the main aim and impact of contracts and vertical integration is to create efficiencies by lowering transaction costs associated with market exchange (Williamson & Masten, 1999). The exchange relationship between two participants in the value chain is characterised by the following important stages:

- searching for trade opportunities and partners;
- analysing information about the products and chain participants one wishes to deal with;
- deliberating the terms of trade;
- transferring the goods, services, titles, cash, etc.;
- monitoring the transfer to determine whether the agreed terms are met; and
- imposing the agreed terms.
There are costs related to each of the stages within the exchange process. Transaction costs related to spot-market coordination include buyer costs associated with searching for suppliers offering acceptable quality products at favourable prices, as well as seller costs associated with determining prices and buyer preferences. Buyers and sellers can reduce some of these costs by entering into a contract before production is completed, but might still encounter other types of costs. *Ex ante* (prior to reaching an agreement) contracting costs are costs associated with drafting, negotiating, and preserving contracts. *Ex post* (following an agreement) costs are costs associated with the enforcing of agreements and may require quantifying damages incurred by a disadvantaged contracted party, enforcing penalties, and the compensation of a disadvantaged party (Martinez, 2002). Spot-market trading and contracting costs can be reduced by vertical coordination and integration, although it might also introduce new types of transaction costs, such as costs relating to the acquiring, processing and communicating of information within a firm (Rehber, 2000). As illustrated in Figure 2.7 below, businesses choose a method of vertical coordination based on a comparison of the net effect of transaction costs on profit margins (Putterman & Kroszner, 1996).

Transaction costs and the efficiency of the various coordination mechanisms also partially depend on the relationship between the transacting parties, i.e. the principal and the agent. The relationship between the principal and agent is managed through a set of institutional arrangements, or better known as the governance structure, which in turn is determined by the characteristics of the transaction. An efficient vertical governance structure should assist in minimising transaction costs (Rehber, 2000).

Based on the TCE model, which depends on the presence of transaction costs, three transaction cost-related motives for vertical coordination and integration exist. These motives relate to the specificity of assets used in the production/processing process, and uncertainty and risk in the industry, as well as product comparison and evaluation costs (Martinez, 2002). These three motives seldom act as a sole motive for vertical coordination and integration, and more often act in combination as motives towards attaining vertical coordination and integration (Rehber, 2000).

The three motives for vertical coordination and integration that are related to transaction cost/efficiency will be discussed briefly in the following sections.
2.5.1.1 Asset Specificity

Asset specificity refers to the specialised nature of the human and/or physical assets that are needed to complete a transaction (Rehber, 2000). The degree of asset specificity is determined by the extent to which assets are specifically designed and/or located for a specific and specialised application or user in a value chain activity. The redeployment of specialised assets locked into a value chain relationship comes with a considerable loss in productive value, which results in sizeable quasi-rents.

The quasi-rent value of an asset can be defined as the value of an asset in its next best use by an alternative user (Klein, Crawford & Alchian, 1978). Only limited alternative users, and thus potential trading partners, exist for highly specialised assets, which significantly lowers the demand for, and thus the value of, these types of assets during the process of redeployment. The impending loss involved with the redeployment of specialised assets could expose the investing party to opportunistic behaviour by other parties aiming to gain quasi-rents and generate abnormally high returns (Martinez, 2002).

A situation of reduced numbers of buyers and sellers (oligopolistic and oligopsonistic market structures) can lead to small-number bargaining problems (Frank & Henderson, 1992). A combination of specialised assets and a small-number bargaining situation increases the opportunity for opportunistic behaviour because limited numbers of buyers and sellers for specialised assets make alternative exchanges difficult to arrange. Asset specificity and small-number conditions, however, can contribute to the establishing of lasting exchange relationships (Martinez, 2002).

Asset specificity can be categorised as physical, site/location, or momentary/temporal specific. Physical specificity is determined from the physical features of an asset. Special-purpose equipment with limited alternative application signifies physical specificity (Klein et al., 1978).

Site or location of asset deployment specificity exists when producers and processors establish facilities close to each other to reduce transportation costs. Owing to relocation costs of facilities being expensive, site specificities commit chain participants to a trade relationship for the economic lifespan of the asset. Transaction costs related to significant site
specificities in an industry suggest that vertical integration is a superior method of organising transactions, rather than any of the other methods of vertical coordination (Martinez, 2002).

Temporal or momentary specificity refers to the timing of asset availability and the impact it can have on product value. Temporal specificities can exist when a producer of a perishable product, or a producer experiencing cash flow constraints, has difficulty in finding alternative processors/marketers on short notice. Momentary specificities have less impact in competitive markets where large numbers of buyers and sellers exist and thus create increased competition for a product, as well as alternative buying and selling opportunities for market participants (Pirrong, 1993).

Once a business invests in highly specialised assets, and the potential for related abnormal quasi-rents is created, the possibility for opportunistic behaviour becomes very real. As assets become more specific and potentials for quasi-rents from opportunistic behaviour are created, the cost of contracting will increase (Klein et al., 1978). The business investing in the specialised asset will be forced to allocate more resources in its effort to specify water-tight contracts to prevent opportunistic behaviour by other parties. Contracting parties do not always honour contracts, which can introduce costs related to contract violation investigations, court litigation and ultimately the compensation of a disadvantaged party (Martinez, 2002).

As illustrated in Figure 2.7 below, the costs of contracting with the aim of preventing opportunistic behaviour resulting from asset specificity will, at a certain point, increase faster than the costs of vertical integration, and consequently, vertical integration will become increasingly attractive as vertical coordination mechanism (Klein et al., 1978). Alternative approaches of vertical coordination can be chosen to reduce transaction costs. In Figure 2.7 below, K is the level of asset specificity, \( M(k) \) represents transaction costs associated with spot-market coordination, \( C(k) \) represents the transaction costs associated with contracting, and \( V(k) \) represents the transaction costs associated with vertical integration. Each approach to vertical coordination is stated as a function of asset specificity. At a limited degree of asset specificity (\( K<K_1 \)), transaction costs associated with spot-market coordination are minimal. As asset specificity increases to moderate levels (\( K_1<K<K_2 \)), contractual agreements are found to be more suited for minimising transaction costs. For transactions types associated with
higher degrees of asset specificity (K>K2), vertical integration becomes the most efficient approach for minimising transaction costs.

![Figure 2.7: Relationship between asset specificity, transaction costs, and methods of vertical coordination](image)


### 2.5.1.2 Uncertainty/Risk

As in the case of asset specificity, transactions can differ with regard to levels of uncertainty/risk. According to Williamson (1996), uncertainty/risk can originate from three basic sources, which are:

1. Uncertainties attributable to technological changes, unpredictable changes in supplier and consumer preferences and behaviour, and random acts of nature.
2. Uncertainties arising from lack of timely communication resulting in the inability to determine decisions and plans made by other value chain participants.
3. Uncertainties arising from strategic behaviour regarding non-disclosure, disguise, or distortions of information by other value chain participants.

In markets with significant asset specificity, increasing levels of uncertainty are expected to lead to methods of coordination that transfer more control over functions to the integrator (Martinez, 2002).
Bounded rationality can be defined as “the limited ability of the human mind to find and formulate solutions for extensive problems of which the solutions are required for objectively rational behaviour in the real world” (Williamson, 1996). The rationality of decisions made by humans is limited by the information they have available at the moment of decision making, the intellectual limitations of their minds, and the time available to make the decision (Williamson, 1996). Due to bounded rationality, it is virtually impossible and very costly to make provision in advance for all possible eventualities when coordinating vertically through contracting. Bounded rationality makes it necessary for value chain participants to adjust or resolve issues which originally had been excluded from the contract (Martinez, 2002). Bounded rationality thus makes it almost impossible and extremely expensive to formulate an infallible and comprehensive contract, and therefore contracting parties are susceptible to opportunistic behaviour when contracts are renegotiated owing to changing market conditions (Martinez, 2002). As levels of uncertainty escalate, the monitoring of contracted parties for defaults in contract specifications, as well as the verification of possible contractual breaches, becomes progressively difficult. In a situation of low asset specificity, and thus limited opportunity for opportunistic behaviour, uncertainty is expected to have a negligible effect on vertical coordination. This is attributable to the fact that owners of assets with low specificity place little value on on-going relationships with other value chain participants for preventing opportunistic behaviour. The need to adapt to market conditions owing to unexpected events is reduced, because if needed, alternative trade opportunities can be quickly arranged (Martinez, 2002).

In markets with high asset specificity, increasing levels of uncertainty are expected to lead to methods of coordination that transfer more control over value chain functions to the integrator. Contracting parties experiencing increasing uncertainty may thus respond by progressing up the spectrum of control from marketing contracts to vertical integration. With frequent high levels of uncertainty, vertical integration is expected to become more frequent (Vaselska, 2005). Coordination through contracting depends on the ability to anticipate potential problems. Vertical integration, on the other hand, requires no contract revisions and accommodates adjustment to evolving circumstances as they happen (Masten, 1996). Vertically integrated businesses easily adapt to changing conditions because the probability of opportunistic behaviour in such businesses is low, top management can resolve disputes
within the business, similar viewpoints can assist with planning, and access to relevant information can reduce negotiations (Masten, 1996).

2.5.1.3 Measurement/Product Comparison Costs

Imbalances in information between value chain participants regarding product value, product properties and producer effort can contribute to transaction costs. Due to information imbalances, value chain participants can be forced to engage in expensive searching and sorting activities to collect information about the value and properties of a product. Certain producers are involved in trading in low- and high-quality products at the same price, which could force the buyer to invest resources to distinguish between good- and poor-quality products and avoid those that are overpriced in relation to their quality features (Martinez, 2002). Contracts rewarding efficient producer performance will thus direct buyers to a process of specified production standard and efficiency evaluation, which ultimately contributes towards the increase of transaction costs (Martinez, 2002).

Vertical coordination can reduce transaction costs related to product quality and feature evaluation, and initiate the process towards brand building. Trusted brand-named products are likely to reduce consumer fears regarding product quality and make the buying decision easier. Branded products associated with quality and accurate product features add to brand reliability and can lead to sustainable and preferred consumer demand. Instead of the consumers absorbing the cost of product quality and feature assessment at the moment of product purchase, processors can evaluate product characteristics less expensively and more efficiently further upstream in the value chain (Martinez, 2002). Replacing product quality and feature measurement done by consumers with upstream, less costly evaluation by producers/processors reduces total evaluation costs in the value chain. This saving in evaluation costs leaves more gains to be shared between value chain participants (Martinez, 2002).

In total, the gaining of control over transaction costs through vertical coordination/integration will improve the competitiveness and thus market position of a business by leaving more gains/profits to be distributed amongst value chain participants in the coordinated/integrated value chain. Improved competitiveness/market position created by
reduced transaction costs and related improved gains/profits places pressure on other market participants to follow coordination/integration trends in order to remain competitive, or else lose market share (Martinez, 2002).

2.5.2 The creation or enhancement of market power motive

Economic analysis show that the competitive consequences of vertical integration depend on the structure of upstream and downstream markets (Loertscher & Reisinger, 2014). Riley (2012) defined market structure as the organisational and other characteristics of a market. The following features are included (Riley, 2012):

i. The number of businesses operating in the market.

ii. The market shares of the largest businesses in the market.

iii. The nature of costs that influence the competitiveness of the businesses.

iv. The degree of vertical integration evident in the industry.

v. The extent of product differentiation amongst businesses operating in the industry.

vi. The market structure under which sellers operate in an industry (including the possibility of monopsony power).

vii. “Market churn” which indicates how many customers are prepared to switch their suppliers over a given period of time when market conditions change.

Among the most important elements of a market structure is the market power which a business possesses within a specific industry. Market power is the ability of a business to set the price for a product without reducing profit or losing market share, as well as its ability to shut competitors out of a market (Bhuyan, 2005). Market power usually is a result of industry concentration, product differentiation and cost advantages. Lasting market power that generates above-normal profits is protected by barriers to entry which preserves above-normal profits through the prevention of the entry of new entrants into a specific industry. Vertical integration that fails to increase market power through the elimination of competitors or the raising of entry barriers is unlikely to have any negative impact on consumers (Riordan, 2005).
An equally important element of market structure used for analysing vertical coordination is the ability of contracts to control the conduct of businesses. Contract power refers to the ability of a contract to prevent a business from behaving opportunistically (Williamson, 1967). If contracts have sufficient power to control business conduct, very little potential for improved conduct control through vertical integration exists (Riordan, 2005).

The level of incompleteness of contracts (the existence of loop holes in contracts) determines the extent of opportunity available for opportunistic behaviour by value chain participants. This can serve as motive for vertical integration in order to replace insufficient contracts and thus eliminate opportunistic behaviour by value chain participants. Eliminating contracts as chain coordination and governance mechanisms through vertical integration can lead to the establishing of increased market control and power in the hands of the integrator, thus shifting the opportunity for opportunistic behaviour away from other value chain participants towards the integrator (Riordan, 2005).

Based on the fact that many industries in the food manufacturing sector have been found to possess market power, a valid debate exists whether vertical integration can increase the market power of food processing industries. The reasoning is that if increased vertical integration results in increased market power, food processing businesses may be motivated to become involved in vertical integration in order to enhance their market power, which would impact on the welfare of other value chain participants (Bhuyan, 2005).

Evidence exists that vertical integration enhances oligopolistic value chain coordination and often is a condition for the successful exercise of market power under an oligopolistic market structure (Martinez & Reed, 1996). According to Loertscher and Reisinger (2009), vertical integration is more likely to be pro-competitive in an industry with an increasing upstream supply curve and an oligopolistic (limited sellers) market structure. Scherer and Ross (1990) argue that businesses get involved in vertical integration not to only increase the level of market power at one link of the value chain, but also to increase market power throughout each successive value chain link.

Under certain market conditions, such as downstream oligopsony and oligopoly market structures, market power can be created and enhanced through the process of vertical
coordination and integration. These market conditions create a scope for opportunistic behaviour such as the generation of above-normal profits, which in itself may serve as a motive for vertical coordination and integration (Loertscher & Reisinger, 2014).

The argument that vertical integration would increase efficiency and would not harm competition and welfare becomes questionable (Bhuyan, 2005). According to Scherer and Ross (1990), the effect of vertical integration on market power needs careful evaluation and the rigid insistence that market power cannot result from vertical integration is unjustifiable.

2.5.3 Agro-food chain specific vertical coordination and integration motives

According to Vaselska (2005), the specific market and production characteristics associated with agro-food chains can serve as additional motives for vertical coordination and integration. These motives include:

i: Improved ability of a business to innovate and differentiate. Backward integration may allow the business to acquire specialised and superior inputs which enable it to improve and differentiate its final product. Forward integration gives the business improved and timely access to market information. This allows for rapid and accurate adjustment to market conditions and product features when demanded.

ii: The ability to guarantee a required supply of quality raw material in a timely manner. In a situation of limited raw material (input) availability owing to limited production/availability or seasonal production patterns, backward integration towards the raw material/input source can eliminate availability, quantity and quality input uncertainty.

iii: Perishability of production. Due to high grades of perishability associated with agro-food chain products, forward integration towards the processing activities in the value chain can remove opportunistic behaviour by downstream processors who exploit time constraints associated with the processing of perishable products.

iv: Increased attention of consumers concerning both product and method of production. Consumer awareness regarding social and ecological practices and processes employed during the production of a product can prompt processors to
vertically integrate in order to ensure consumer-acceptable social and ecological production processes.

2.6 Price transmission

The theory of price is one of the fundamentals of neo-classical economics which, with Keynesian economics, forms the neo-classical fusion which dominates today’s modern mainstream economics. The price theory involves the analysis of supply and demand with the purpose of determining an acceptable price for a product. The objective is to achieve equilibrium between the quantity of product supplied and the quantity of product demanded by the consumer. This principle allows for price adjustment as market conditions change. Within this theory, prices are responsible for efficient resource allocation, as well as output mix decisions, by economic actors, while price transmission between value chain levels integrates markets vertically and horizontally (Peltzman, 2000; Meyer & von Cramon-Taubadel, 2002).

Traditional analysis of spatial price relationships began over 60 years ago, with the blueprint widely called the Enke-Samuelson-Takayama-Judge equilibrium model for spatial price equilibrium relationships, introduced by Enke (1951), Samuelson (1952) and Takayama and Judge (1964). In the field of agricultural economics, price transmission and market integration analysis has received considerable attention in the past 50 years (Amikuzuno & Ogundari, 2012).

Price transmission studies are useful and important in many respects. Price transmission studies provide understanding as to how, in terms of speed, direction and magnitude, product price changes in one market are transmitted vertically to another and what role profit-seeking value-chain participants play in this regard. It also provides knowledge about the extent of market integration, as well as which markets function efficiently (Goletti & Babu 1994; Rapsomanikis et al., 2003). Of special interest in price transmission studies is the process of incomplete price transmission, also known as asymmetric price transmission (APT) between agricultural value chain levels.
2.6.1 Asymmetric price transmission

The possible existence and perhaps regular occurrence of APT has significant importance. Peltzman’s (2000) comprehensive study of 165 producer goods and 77 consumer goods concluded that “In two out of three markets, output prices rise faster than they fall”. Due to the prevalence of APT experienced during Peltzman’s studies, its occurrence can rather be seen as the rule than the exception and could point to the existence of gaps in economic theory. APT could also have welfare implications for value chain participants in that buyers would not benefit from price reductions or sellers from price increases that would, under conditions of symmetry, have occurred sooner and/or at a greater magnitude than observed. APT is thus responsible for altering welfare distribution, more than would be obtained under symmetry conditions, because it changes the timing and/or the size of the welfare adjustments that are associated with price changes (Meyer & von Cramon-Taubadel, 2004).

A vertical price relationship, from production to consumption and vice versa, can typically be described and categorised according to the magnitude, speed, nature and direction of price adjustments happening through the value chain due to market shocks caused at different levels of the value chain (Meyer & von Cramon-Taubadel, 2004; Vavra & Goodwin, 2005).

The magnitude of a price adjustment describes the response at each level of the supply chain due to a shock of a given size at another level of the supply chain. The speed (lag) of a price adjustment describes the tempo at which price transmissions between different levels of the supply chain takes place. The speed of vertical price transmission between the different links in the value chain is determined by the behaviour of the market agents who are involved in the transaction that links the producer, distributor, processors, wholesaler retailer and consumer market levels (Meyer & von Cramon-Taubadel, 2004; Vavra & Goodwin, 2005). Expensive adjustments to price (high transaction costs) or price adjustments subject to any form of limitation may, due to delays in the transmission process, induce a lag in price signals passed from one value chain level to the next. The nature of the price adjustment measures whether the price adjustments following the positive or negative shocks are transmitted either symmetrically or asymmetrically to other levels of the supply chain. The direction of the price adjustments measures whether the shock is transmitted upwards or downwards in the supply chain (Vavra & Goodwin, 2005).
2.6.2 Types of asymmetry

Two fundamental types of asymmetry are respectively illustrated in Figures 2.8 and 2.9 below, in the context of price transmission. Price \( P \text{ out} \) is assumed to depend on another price \( P \text{ in} \) that either increases or decreases at a certain point in time (Meyer & von Cramon-Taubadel, 2004). In Figure 2.8, the magnitude of the response by \( P \text{ out} \) to a change in \( P \text{ in} \) depends on the direction of the price change. A \( P \text{ in} \) increase is fully transmitted as a \( P \text{ out} \) increase (symmetric price transmission with regard to magnitude). A \( P \text{ in} \) decrease is only partially transmitted as a \( P \text{ out} \) decrease (APT with regard to magnitude). The magnitude of the \( P \text{ in} \) reduction not transferred to the \( P \text{ out} \) is represented by the yellow shaded area. The size of the transfer entirely depends on the price changes and transaction volumes involved (Meyer & von Cramon-Taubadel, 2004).

![Figure 2.8: Asymmetric price transmission (magnitude)](source)

Source: Meyer (2002)

In Figure 2.9, the speed of the response by \( P \text{ out} \) depends on the direction of the change in \( P \text{ in} \). A \( P \text{ in} \) increase is fully transmitted without any time lag as a \( P \text{ out} \) increase (Symmetric price transmission with regard to speed and magnitude). A \( P \text{ in} \) decrease is fully transmitted with a time lag as a \( P \text{ out} \) decrease (APT with regard to speed but symmetric with regard to magnitude). The magnitude of the \( P \text{ in} \) reduction caused by the time lag of price transfer not transferred to the \( P \text{ out} \) is represented by the yellow shaded area (Meyer & von Cramon-Taubadel, 2004).
Obviously, combinations of these two fundamental asymmetries are possible. In Figure 2.10 below, an increase in $P_{\text{in}}$ is fully transmitted with a two-period ($t_1$ and $t_2$) time lag as a $P_{\text{out}}$ increase (APT with regard to speed but symmetric with regard to magnitude). A $P_{\text{in}}$ decrease is partially transmitted with a three period ($t_1$, $t_2$ and $t_3$) time lag as a $P_{\text{out}}$ decrease (APT with regard to speed and magnitude of transmission). The magnitude of the $P_{\text{in}}$ reduction caused by the time lag of price transfer not transferred to the $P_{\text{out}}$ is represented by the yellow shaded area (Meyer & von Cramon-Taubadel, 2004).
Asymmetry can further be classified as either positive or negative. Positive APT is illustrated in Figure 2.11 below. If $P_{out}$ reacts more fully or rapidly to an increase in $P_{in}$ than to a decrease, the asymmetry is termed positive (Meyer & von Cramon-Taubadel, 2004). Positive APT can thus be defined as a set of reactions according to which any price movement that squeezes/reduces the margin (i.e. an increase in input prices ($P_{in}$) or a fall in output prices ($P_{out}$) is transmitted more rapidly and or completely to $P_{out}$ or $P_{in}$, respectively. From the viewpoint of the consumer, positive asymmetry is “bad” (Vavra & Goodwin, 2005).

![Figure 2.11: Positive asymmetric price transmission](image)

Source: Meyer (2002)

Negative APT is illustrated in Figure 2.12 below. When $P_{out}$ reacts more fully or rapidly to a decrease in $P_{in}$ than to an increase, the asymmetry is termed negative (Meyer & von Cramon-Taubadel, 2004). Negative APT can thus be defined as a set of reactions according to which any price movements that stretch/increase the margin (i.e. decrease in input prices ($P_{in}$) or increases in output prices ($P_{out}$) are transmitted more rapidly and or completely to $P_{out}$ or $P_{in}$, respectively. From the viewpoint of the consumer, negative asymmetry is “good” (Vavra & Goodwin, 2005). Price transmission does not have to flow from input ($P_{in}$) to output ($P_{out}$) prices. Upstream or backward price transmissions from output prices back to input prices are also possible (Vavra & Goodwin, 2005).
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Figure 2.12:  **Negative asymmetric price transmission**

Source: Meyer (2002)

The final criterion for classifying APT refers to whether it affects vertical or spatial price transmission. Vertical price transmission deals with price transmission up and down the value chain. Spatial price transmission deals with price transmission amongst producers of the same product at the same level of the value chain at different locations (Meyer & von Cramon-Taubadel, 2004). An example of spatial APT would be an increase in product A’s export prices from country A that causes an observable reaction in the export price of the same product from country B. As with vertical APT, spatial APT can also be categorised according to speed, magnitude and whether it is positive or negative (Vavra & Goodwin, 2005).

**2.6.3 The causes of asymmetric price transmission**

In economic theory, the phenomenon of APT in a food value chain can mainly be explained in terms of the product’s competitive market structure and its inherent characteristics determining its suitability for building a storable inventory, as well as the presence of adjustment or menu costs (Reverodo, Nadolyak & Fletcher, 2004). Other miscellaneous causes of APT such as political intervention and asymmetric information also exist. The main and miscellaneous causes of APT will be individually discussed in short in the following sections.
2.6.3.1 Market structure and market power

Prices of agricultural commodities are characterised by high levels of fluctuation (Lechanova, 2011). Under conditions of perfect competition, price fluctuation/changes are fully transmitted through the entire value chain to the final consumer. Most agro-food chain markets, however, operate under imperfect conditions, allowing middlemen to abuse market power, which consequently results in APT between value chain levels. Price transmission studies conducted by Kinnucan and Forker (1987), Miller and Hayenga (2001), Lechanova (2006), and Piesse and Thirlle (2010) in a wide range of agricultural industries, including the U.S. dairy and pork industry and the Czech meat value chain, support Peltzman’s (2000) in his observation that APT is the rule rather than the exception and that APT is widespread among the majority of producer markets.

Most studies on APT refer to imperfect market structures as an explanation for asymmetry. The logic of the market power argument is based on the principle that firms in a collusive industry experiencing input price reductions (margin stretching price changes) will slowly pass on very little of the input price reductions to the next non-integrated chain participant by keeping output prices at existing levels as long as possible and thus increase profit margins. At the same time, collusive behaviour promotes the rapid passing on of almost all, if not all, of the input price increase (margin squeezing price changes) to the output price in order to retain their existing margins (Vavra and Goodwin, 2005). Related studies performed by Boyd and Brorsen (1988), Griffith and Piggot (1994), Mohanty, Peterson and Kruse (1995), Cesar, Denis and Stanley (2004), and McLaren (2013) support the findings of the Vavra and Goodwin study that, due to the existence of imperfect competition and thus of market power, input price increases in the agricultural value chain are passed on faster and more completely to the final consumer than input price reductions are.

In conclusion, many authors suggest that market power can lead to APT. The majority predict that market power in a pure monopoly context will lead to positive APT. In a more general oligopoly context, both a negative and a positive APT are possible, depending on market structure and conduct.
2.6.3.2 Adjustment and menu costs

APT can be explained by adjustment costs that arise when firms increase or decrease their output and/or the prices of inputs and/or their product. If these costs are asymmetric with regard to an increase or decreases in output volumes and/or prices, the adjustment will be asymmetric. In the case of product price changes, the adjustment costs are also known as menu costs (Meyer & von Cramon-Taubadel, 2004).

Menu costs are costs incurred by a business during the process of changing its prices. Menu costs can include the reprinting of price lists, retagging of products on the shelf, and advertising price changes, as well as the labour associated with re-pricing. In certain situations, menu cost changes at retail level may not be transmitted on to retail prices due to the risk related to the retailer’s reputation if its price changes are too frequent (Vavra & Goodwin, 2005). Adjustment costs make the changing of prices expensive and this discourages value chain participants from immediately adjusting prices (if at all), which ultimately leads to adjustment lags and asymmetric price transmission (Meyer & von Cramon-Taubadel, 2004). Uncertainty about whether the price shock originating from a neighbouring level of the value chain is permanent or temporary increases the reluctance to respond to price signals (Vavra and Goodwin, 2005). Traders in perishable products might be hesitant to increase prices out of fear of reduced sales, resulting in unsold and spoiled stock (Meyer & von Cramon-Taubadel 2004; Ward, 1982). The net result of menu costs is that prices are sticky, and menu costs can thus be an important causal factor of APT (Vavra & Goodwin, 2005).

In the U.S. beef market, Bailey and Brorsen (1989) demonstrate that meat packers, unlike owners of feedlots, experience considerable fixed costs. Competing meat packers may over the short term thus rather reduce their margins by bidding farm prices up faster than bidding them down (negative APT) in order to secure sustainable input inflow into their packing facilities in an attempt to keep the plant operating at or near full capacity. Peltzman (2000) formulated an example of positive APT by arguing that it would be easier for a firm to reduce inputs to facilitate a reduction in output, rather than sourcing new inputs to increase output. The sourcing of inputs to initiate increased output will involve increased search costs and the possible paying of premium prices that would result in reduced margins.
2.6.3.3 Inventory management

Inventory building and management can be an important element of a firm’s strategy to adjust to exogenous price shocks and is occasionally recognised as a potential cause of APT (Meyer & von Cramon-Taubadel, 2004). The existence of inventories introduces additional price firmness (prices are sticky and do not change easily) because of the “shock absorbing” effect that inventories have on supply and/or demand (price) shocks of a commodity. The durability of a product, and thus the ability to build and/or release an inventory of a storable product during periods of low demand and/or over supply, creates the opportunity to retain prices at acceptable levels. In periods of low demand, firms will adjust the quantity produced and increase inventory rather than decreasing output prices. If stock holding firms reduce prices, they will do so slower as compared with supplier firms in order to avoid running out of stock. In periods of high demand, stock holding firms will increase prices of stock held, thus stretching margins even further, resulting in negative APT. Keeping inventory because of a reluctance to run out of stock results in related inventory costs that tend to squeeze margins, thus resulting in a positive APT (Reagan & Weitzman, 1982). Inventory building and the managed/controlled releasing of product from stock thus contributes to APT and profit maximisation (Reverodo et al., 2004).

Several studies have been done in recent years focusing on the impact of inventories and inventory levels on price transmission. Deaton and Laroque (1992) analysed the behaviour of the prices of commodities held in inventory. They found that inventory demand is more elastic at lower prices. Consequently, a shock at higher prices when inventory levels are low triggers a larger price reaction in the value chain than does an equal shock when prices are low. Abdessalem, Lota and Gervais (2011) investigated how inventories impact on price transmission in the Canadian chicken industry. The study found that price transmission is lower (higher) when inventories are below (above) a target, which in turn is a function of domestic sales.

2.6.3.4 Miscellaneous causes of APT

A number of additional causes for APT have been identified that cannot be included directly under market power, adjustment costs or inventory management. Political intervention and
asymmetric information are both factors that could contribute to APT in agro-food value chains (Wohlgenant, 2001).

2.6.3.4.1 Political intervention

Price support, often in the form of floor prices, is quite common in agriculture. A political intervention through policy implementation could lead to APT if wholesalers or retailers believe that a reduction in farm prices will only be temporary because it will trigger government intervention resulting in price support/price “correction” by way of floor prices (Kinnucan & Forker, 1987).

2.6.3.4.2 Asymmetric information

The difference in the abilities of firms (economy of scale) to efficiently gather information can result in asymmetric information. Larger firms, due to economy of scale, have a stronger ability to gather and analyse price and demand information. APT can thus result from asymmetric information available to competing firms. APT can also arise owing to inefficient market information reporting and recoding systems causing distortions in price series data (Bailey & Brorsen, 1989).

Asymmetric information, with specific reference to distorted price reporting processes, tends to create spurious APT, while political/government intervention creates true APT (Meyer & von Cramon-Taubadel, 2004).

2.7 The implications of APT

The social welfare of value chain participants depends on the welfare of all value chain participants, i.e. producers, wholesalers, retailers and consumers. Welfare measures are based on two elements, namely efficiency (profit) and equity (people). Efficiency has to do with the creation of value add (profit), while equity is concerned with the division of the added value (profit) between the respective value chain participants (Tirole, 1988).

Tirole (1988) evaluates value chain coordination strategies by assessing their impact on value chain performance, with specific reference to producer profit division throughout the value chain. Many of the solutions suggested by Tirole (1988) relate to a position of market power.
These solutions maximise the supply chain’s value added, and thus profits. However, profits accrue to the value chain participant with dominant market power, either as a processor or as a retailer. All other value chain participants do not necessarily gain from supply-chain efficiency/profits generated from added value. Profits gained from a position of market power may be redistributed along the value chain, but the redistribution is not compulsory. Market power does not disappear with supply-chain coordination. Supply-chain coordination may even be a mechanism to establish and maintain market power, thus impacting on vertical price transmission and the level of equity involved in the division of profits along the value chain. Equity (division of profits along the value chain) is at stake when businesses are able to exercise market power. Market power may be exercised on a permanent or temporary basis by charging high consumer prices and/or by commanding low supplier prices, by enforcing non-price specifications, and by shifting price risks to other value chain participants (Tirole, 1988).

For whatever reason APT might exist within the value chain, it will, subject to the specific situation, impact either favourably or negatively on value chain participants. Under APT conditions, a favourable impact on one value chain participant will at some point have a negative welfare impact on other upstream or downstream value chain participants. The main concern with APT is the magnitude and term of the welfare impact it exercises on value chain participants, i.e. the community (Boyd & Brorsen, 1988).

2.8 Conclusions

A number of methodologies and approaches available for analysing value chains have been identified and discussed in this chapter. Each of the discussed value chain analysis methodologies has its strengths, which makes it partially but highly applicable in specific sections of this study. During this study, different value chain analysis principles and procedures will thus be drawn on, selectively, from the different methodologies and applied where most appropriate and suited.

In order to progress from the theoretical background of the discussed theories, concepts and principles relevant to the study, an actual application of all concepts within the chosen industry and in the context of research topic is required. The first step in the process of
moving from theory to the actual execution of the study would be the establishing of a comprehensive overview of the global and South African macadamia industry. The detailed global and South African macadamia industry overview will lead into the performing of a value chain analysis of the South African macadamia value chain. As a first step, value chain analysis starts with chain mapping in order to obtain an overview of the chain, the product flows, chain participants, and types of interaction between the chain participants. Completing the basic activities related to VCA and the actual mapping of the value chain will contribute to gaining a better understanding of which actors are all involved and what their respective roles/functions comprise in the value chain, the different activities and flows between the different actors in the value chain, and of what the volume and value of physical flows amount to.

Once the VCA has been completed, the value chain can be analysed in terms of its structure, performance (level of value-add, efficiency, competitiveness, welfare distribution) and value chain participant conduct. In the context of this specific study, the South African macadamia value chain will be analysed with regard to vertical value chain coordination/integration, the existence of market power, and the impact thereof on price transmission throughout the value chain.
Chapter 3 Overview of the global tree- and macadamia nut industries

3.1 Introduction

For thousands of years before any European settlement grew in Australia, the Aborigines of Eastern Australia feasted on the native nuts which grew in the rainforest on the wet slopes of the Great Diving Range. One of these native nut types was called gyndi or jindilli, which over time was in the mouths of early Europeans transformed into kindal kindal. This nut type today is known as the macadamia nut. The high oil content of these nuts was highly sought after as an important addition to the indigenous diet. The Aborigines also pressed the oil from the nuts to use as base for face and body paint, as well as a carrier medium for medicinal plant extracts used to treat ailments (McConachie, Bevis, Heap, Poole & Prowse, 2014).

Europeans only became aware of the macadamia in 1828 when Allan Cunningham, without eating any of the nuts, documented its existence. In 1858, Ferdinand von Meuller, a British botanist, and his colleague Walter Hill, the director of the botanical gardens in Brisbane, gave the tree the scientific name Macadamia integrifolia. The tree was named after von Meuller’s best friend, Dr John MacAdam, a respected scientist and Australian politician during that time (McConachie et al., 2014).

With them not knowing about historic Aboriginal macadamia nut consumption, it was still believed by Europeans that macadamia nuts were poisonous. It took over 30 years for the first accidental but harmless consumption of macadamias to occur when, in 1858, a young boy under instruction of Walter Hill cracked and secretly ate some nuts actually destined for germination trials. After realising that macadamia nuts were not poisonous but rather tasty, an Australian gentleman with name of Tom Petrie planted the first private macadamia orchard in 1866. Since then, commercial production of macadamias has been introduced to many tropical and sub-tropical areas all over the globe, including its native country Australia, Hawaii, South Africa, Zimbabwe, Kenya, Guatemala, Costa Rica, Ecuador and Brazil (INC, 2013).
Constructing the chronological development of the global macadamia industry, from the time of it being found to be non-poisonous and edible, to the first modern commercial production in Hawaii, it is clear that the modern global commercial macadamia nut industry is still extremely young, when compared with other tree nut types.

Pistachio seeds were a common food as early as 6750 BC. Remains of pistachio shells and seeds along with nut-cracking tools were discovered by archaeologists at the Gesher Benot Ya’aqov site in Israel’s Hula Valley that dates back to 78,000 years ago. The pistachio is mentioned once, in Genesis 43:11, as is the walnut in Song of Songs 6:11, while almond is mentioned many times in different parts of the Bible (Goren-Inbar & Sharon, 2002).
As mentioned in the background and problem statement section of Chapter 1, and confirmed by the timeline in Figure 3.1 above, the macadamia nut occupies a minute spec in time, in comparison with the history of edible tree nuts such as the pistachio, walnut and almond.

This chapter starts off by providing a short synopsis of the global tree nut industry. It then further proceeds with a focused overview of the global macadamia industry.
3.2 Global tree nut overview

The global tree nut basket consists of nine main nut types, the production of which is mainly located in North America, the Middle East, Asia and Africa (INC, 2015). Figure 3.2 below shows a composition of the global tree nut basket, as well as the volume contribution that each nut type made to the nut basket for the period 2006 to 2013. Measured on a kernel basis, the “big five” of the nut basket consists of almonds, pistachios, cashews, walnuts and hazelnuts. Combined, the big five nut types make up 95% of the volume of global tree nut production. The “small four”, pecans, macadamias, Brazil and pine nuts, make up the remaining 5% volume of tree nut production, with macadamias being 1.2% of the total in 2013 (Lee, 2014; INC, 2015). Figure 3.2 reflects the general upward trend in global tree nut production volumes observed over the last eight years.

Figure 3.2: Global tree nut production (Kernel equivalent)
Source: INC (2014)

Global tree nut production and production values, measured in tonnes kernel equivalent and USD terms, respectively, are shown in Figure 3.3 below. During the last 11 years, the global tree nut industry has experienced a 47% production volume growth and a 241% production value growth. This observed long-term trend in production and production value growth is...
attributable to volumes of publications of medical and dietary research findings by the International Nut and Dried Fruit Council (INC) and many of the world’s tree nut industry associations. These have underscored the benefit of a handful of tree nuts per day contributing to improving human health, increasing longevity, and reducing the risk of heart disease, while having a neutral to beneficial impact on blood cholesterol levels. The continued promotion of these health benefits will sustain, and might even accelerate, the increase in global production, consumption and supply value of tree nuts (Lee, 2014).

![Figure 3.3: Global tree nut production and supply value](source.png)

**Figure 3.3: Global tree nut production and supply value**

Source: INC (2014)

According to Tripodi (2012), this phenomenal growth in world tree nut production and supply value is driven by several factors present in both developed and emerging economies. These driving factors are:

i. Increased consumption due to population growth

ii. Increased per capita consumption due to:
   ii.i rising disposable income of the consumer, and the
ii.ii desires for increased health and wellness, as well as convenience and indulgence, associated with tree nuts.

Figure 3.4 below shows the total global consumption of tree nuts from 2004 to 2013 for the different income economies, as classified according to the World Bank Atlas method. Total global consumption of tree nuts has grown 53% over the last ten years, and was limited to increased consumption in the middle- and high-income economies (INC, 2015).

![Figure 3.4: Global tree nut consumption](image)

Source: INC (2014)

The increased global tree nut consumption by middle- and high-income economies, as observed in Figure 3.4, confirms the driving factors contributing to increased global tree nut production and related production value as identified by Tripodi (2012).

### 3.3 The global macadamia industry

The purpose of this section is to create perspective on the global macadamia industry. Focus is placed on prominent countries and regions of production, global production and consumptions volumes and trends, as well as global macadamia price and supply value trends.
3.3.1 Global macadamia production

Most of the world’s commercially produced macadamia nuts originate from two species, namely *Macadamia integrifolia*, the smooth-shelled type, and *Macadamia tetraphylla*, the rough-shelled type. The smooth-shelled type accounts for the majority of the world output and is preferred because of its higher oil content and superior roasting quality. The rough-shelled type has a higher sugar content and is therefore sweeter (Anon, 1998). Macadamia trees have a productive lifespan in excess of 25 years.

Figure 3.5 below shows the various global production areas of macadamias. In addition to South Africa, the rest of sub-Saharan Africa is emerging as a preferred region of production expansion.

**Figure 3.5: Global macadamia nut production areas**
Source: INC (2013)

Before proceeding any further with an overview of the world macadamia industry, it is important to understand the various methods of volume measurement and reporting as applicable in the macadamia industry. In this overview, four different formats of macadamia volume reporting will be observed:
i. Kernel – fraction of total macadamia crop processed into kernel
ii. NIS – fraction of total macadamia crop retained in shell
iii. Kernel equivalent – total macadamia crop/volume expressed in terms of kernel format
iv. NIS equivalent – total macadamia crop/volume expressed in terms of NIS format.

Global tree nut production in 2013, measured on a kernel equivalent basis, reached 3 255 116 tonnes. Macadamia production in 2013 accounted for only 37 951 tonnes of kernel, or 1.2 %, of total world tree nut production. Figure 3.6 below provides a breakdown of the individual tree nut volumes, as well as the percentage that each nut type constituted of total global tree nut production in 2013 (INC, 2013).

Figure 3.6: Tree nuts production 2013 / tonnes kernel equivalent
Source: INC (2013)

Figure 3.7 below shows, measured as kernel equivalent, macadamia production on a global as well as individual producing country basis during the period 2001 to 2013. It also reflects a forecast of expected global and individual country kernel equivalent production from 2014 until 2022.
Measured on a kernel equivalent basis, global macadamia production in 2013 was dominated by Australia, South Africa and the USA (Hawaii). In 2013, these countries contributed 30%, 25% and 15% of global production, respectively. Other major producers, in declining order of production, were Kenya, Malawi, Guatemala, Brazil, Costa Rica and Zimbabwe (SAMAC, 2014).

On a kernel equivalent basis, African production in 2013 contributed 46% towards global production, up from 21% in 2001. This significant growth in production saw Africa and South Africa surpassing Australia as the leading supplier in 2010 and 2012, respectively. The African macadamia success story is unprecedented in macadamia producing areas around the world. Production has grown from 2,240 tonnes edible kernel valued at USD 21 million in 1996, to 16,020 tonnes valued at USD 225 million in 2013 – a sevenfold increase in production and a tenfold increase in value over 17 years (SAMAC, 2014).

Despite the recent entry of China as a macadamia producer, and whose five year-strategy envisages taking the 2012 estimated tree numbers of 2.4 million to 20 million by 2018, it is
expected that Africa will remain the dominant global production and supplying region until 2023 (Lee, 2014). South Africa has been the driving force behind this growth, accounting for 65% of total African production, and 25% of global production, in 2013.

During the last few years, Australian production has been hamstrung by inclement weather such as flooding and drought. Production declined from a peak of 14 000 tonnes kernel equivalent in 2006 to only 8 400 tonnes kernel equivalent in 2011 and 2013. With new orchards continuously being established, Australian production is expected to grow to 17 000 tonnes kernel equivalent per annum in 2023 (Lee, 2014).

The Hawaiian macadamia industry came to prominence in the 1950s and is presently characterised by old orchards, with very few new orchard developments since 2000. Hawaiian production is expected to remain stable at 5 000 tonnes kernel equivalent per annum for the future. There are new macadamia plantings in a number of Central and South American countries, including Guatemala, Mexico, Costa Rica, Colombia, Bolivia, Ecuador, Brazil and Paraguay (Lee, 2014).

Based on projections as reflected in Figure 3.7 above, it is expected for South Africa and Australia, as current dominating global producers of macadamia, to be joined by China as the third major contributor to global macadamia production. Projections estimate Chinese macadamia production to exceed both South African and Australian production levels within the next nine years. Macadamia production growth in African macadamia producing countries, as well as those of Australia and China, is likely going to double the global production from 41 000 tonnes kernel equivalent in 2014 to 80 000 tonnes kernel equivalent in 2021 (Lee, 2014).

Measured on an NIS basis and as shown in Figure 3.8 below, South Africa became the largest global producer of NIS in 2014 when it produced 46 415 tonnes of NIS equivalent. Australia, which until 2013 was the largest global NIS producer, produced 40 000 tonnes of NIS equivalent for the same period (INC, 2014).
Chapter 3: Overview of the global tree and macadamia nut industries

This change in position of South Africa, surpassing Australia as the largest global NIS producer, is expected to remain in place for the foreseeable future.

Australian macadamia plantings in 2015 covered 17 700 hectares, while South African production is carried out on 19 000 hectares. Based on tree orders placed at SAMAC accredited nurseries, it is estimated for South African production to increase annually by an estimated 1 500 hectares per annum for the next five to seven years (AMS, 2015). Based on 2014 figures, 57% of global macadamia production is concentrated in the hands of Australia and South Africa.

3.3.2 Global macadamia consumption

Macadamias, due to their taste and health attributes, are rapidly becoming popular with consumers on a global scale. Figure 3.9 below reflects, measured on a kernel equivalent basis, the global macadamia production and consumption patterns for the period 2004 to 2014.
From Figure 3.9, it is clear that global macadamia kernel consumption/demand exceeded global kernel production between 2008 and 2011 (INC, 2015). Between 2012 and 2013, global kernel production in turn marginally exceeded global kernel demand. In 2014, the status quo of demand exceeding supply once again returned, and was expected to continue into 2015 and 2016 (INC, 2015). Due to high barriers of entry into the industry, the long waiting period for young orchards to come into full production, and the increasing popularity of macadamias as a relative new nut being introduced to the world market, as well as increasing global per capita income, it is expected that consumption will continue to outpace supply.

Figure 3.10 below shows, on a kernel equivalent basis, the percentage consumption of the global macadamia crop by the major consuming countries for 2013. Australia, the USA and China were the major consumers, respectively consuming 23%, 19% and 17% of the 2013 macadamia crop.
Figure 3.10: Macadamia consumption in kernel equivalent terms per major consuming country for 2013

Source: INC (2014)

Figure 3.11 below shows, measured on a kernel equivalent basis, the consumption trends of macadamia nuts by the major consuming countries over the period 2009 to 2013. Based on 2013 INC statistics, the USA until late 2012 was the largest consumer of macadamia nuts, but has, due to a 42% decline in consumption between 2009 and 2013, been relegated to the second largest macadamia consumer after Australia. Measured in kernel equivalent terms, China is ranked as the third-largest global consumer of macadamias. China’s consumption of macadamias grew more than 600% between 2009 and 2013. Measured on a kernel equivalent basis, it is expected that China would soon overtake the USA as the second-largest global consumer of macadamia nuts.
Figure 3.11: Kernel equivalent consumption trend per major consuming country between 2009 and 2013

Source: INC (2014)

Table 3.1 below shows the major per capita, as well as national, macadamia-consuming countries for 2013. Australia had the largest per capita consumption of all countries. In 2013, per capita consumption by Australians exceeded its closest competitor, the USA, by 279%.

Table 3.1: Major per capita and National macadamia-consuming countries in 2013

<table>
<thead>
<tr>
<th>Country</th>
<th>Per capita (gram/annum)</th>
<th>National consumption (kg/annum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Australia</td>
<td>137.1</td>
<td>3 141 000</td>
</tr>
<tr>
<td>2. USA</td>
<td>36.2</td>
<td>11 420 118</td>
</tr>
<tr>
<td>3. Taiwan</td>
<td>25.4</td>
<td>590 351</td>
</tr>
<tr>
<td>4. Germany</td>
<td>21.8</td>
<td>1 784 100</td>
</tr>
<tr>
<td>5. Japan</td>
<td>20.3</td>
<td>2 572 445</td>
</tr>
<tr>
<td>6. China/Hong Kong</td>
<td>1.3</td>
<td>1 790 349</td>
</tr>
</tbody>
</table>

Source: AMS (2013)
3.3.3 Global macadamia marketing

Macadamia nuts find their way on to the market either as kernel (shelled) or as NIS. Shelled macadamias are primarily consumed as snacks or used as ingredients by candy, ice cream, chocolate, confectionary and muesli manufacturers. NIS macadamias mainly find their way into the snacking market (SAMAC, 2013). Unsound kernel (USK) and macadamia kernel fragments are processed to produce animal feed and pharmaceutical-grade macadamia oil (Anon, 1998).

The global NIS market is expanding rapidly, with increasing volumes being demanded by buyers mainly located in South East Asia. In 2014 thirty-seven per cent of the South African macadamia crop was marketed as NIS, while the remainder was processed into kernel (AMS, 2015). During the same year 28 % of the Australian crop was sold as NIS, while the balance of the crop was processed into kernel. Between 2013 and 2014, Australian NIS sales grew from 5 000 to 11 000 tonnes, which constitutes a 120 % year-on-year growth (AMS, 2015). Due to the increased flow of the macadamia crop towards the NIS markets at the expense of volumes being made available for shelling, kernel supply is under pressure, with year-on-year decreasing volumes of uncommitted stock being available (AMS, 2015).

Figure 3.12 below reflects global macadamia kernel exports for the period 2004 to 2013. Between 2004 and 2012, global macadamia kernel exports grew by 156 %. However, between 2012 and 2013, the volume of global macadamia kernel exports reduced by 40 % (INC, 2015). This decrease in kernel exports resulted from the redirecting of South African macadamias destined for cracking to in-shell exports to the East Asian, and specifically the Chinese, market (AMS, 2015). In 2013, South Africa was the main exporter of kernel and NIS macadamia nuts, exporting in excess of 95 % of own production and contributing 30 % of world macadamia exports (INC, 2013). The USA and China were the main destinations. During the same period, Australia was the second-largest exporting country, with China being the main destination (INC, 2013).
Ninety per cent of global macadamia production (NIS and kernel) is exported, with the major importing countries in 2012 being China, Vietnam, USA and Japan, respectively importing 29.95 %, 20.17 %, 9.81 % and 4.37 % of global production (INC, 2013).

**3.3.4 Gross production value of the global macadamia industry**

Figure 3.13 below shows the global NIS equivalent production volumes and related gross value for the period 2004 to 2013. Although global NIS production volumes, on average, grew annually by 4.7 % between 2004 and 2013, the related gross NIS production value, on the back of weak NIS prices, declined by 55 % between 2004 and 2007. The production value recovery process started in 2007 and continued over a six-year period, during which the global production value of macadamias grew by 333 %, from USD 104 million to USD 450 million. The gross global production value recovery is the combined result of a continued growth in global NIS production volumes and a 207 % NIS price increase from USD 1.00/kg in 2007 to USD 3.07/kg in 2013. The main drivers of the ongoing NIS price increase since 2007 are the
continued growth in global NIS consumption and a lagging NIS production, as reflected in
Figure 3.9 above.

![Graph showing global NIS equivalent production volumes and gross production value](source)

**Figure 3.13:** Global NIS equivalent production volumes and gross production value between 2004 and 2013

Source: INC (2014)

### 3.3.5 Global macadamia price trends

Figure 3.14 below shows the average annual nominal USD import price/kg and nominal Rand producer price/kg for macadamia kernel. USA statistics were chosen because the United States of America is the second-largest global importer and consumer (19.2%) of global macadamia kernel production, and is also the largest importer (42%) of South African macadamia kernel. Price information from both countries, respectively being a major global importer/consumer and a producer, provides a good indication of general macadamia nut price trends in global markets. Figure 3.14 below shows some correlation between the trends of the nominal USD import price and the nominal Rand producer price for macadamia kernel. The US import kernel nut prices have fluctuated between USD 6 and USD 16 per kg over the past 19 years, with an average of USD 9 per kg over the total period.
Early macadamia price crashes experienced in the early 1990s and 2000s were the result of increased competition in world macadamia nut markets caused by supply exceeding demand and the building up of inventory levels (INC, 2014). Because macadamia nuts constitute a permanent crop, it is characterised by nearly fixed, and thus inelastic, short-run supply. Short-run changes in demand during a period of surplus production thus contribute to short-run price fluctuations.

In contrast, the later macadamia nut price crash observed during 2006/2007 resulted from the “subprime” induced global economic crisis (Lee, 2014). All luxury items, including macadamias, typified by a highly elastic demand were severely impacted upon through reduced demand as consumers directed their expenditure away from luxury items towards more essential commodities and savings (Lee, 2014).

The strong recovery in macadamia kernel and NIS prices since 2007 can be attributed to the strong and continuous growth in South East Asian, and specifically Chinese, demand for both product types.
3.4 Conclusion

Tree nuts, with specific reference to pistachios, almonds and hazelnuts, have since 7000 BC been part of mankind’s diet, due to their health, as well as convenience in consumption, attributes. Over many decades, the tree nut selection has grown to nine different nut types, the global production of which is dominated by the “big five”, namely almonds, pistachios, cashews, walnuts and hazelnuts. The remaining four minor nut types consist of pecans, macadamias, Brazil and pine nuts.

Commercial macadamia production only started in the 1950s, and in 2013 contributed a mere 1.2 % of total tree nut production volumes. Macadamia production is mainly concentrated in Australia and Africa. African production in 2013 contributed 46 % of global production. In 2014, 57 % of global macadamia production was concentrated in the hands of Australia and South Africa.

Global macadamia consumption/demand consistently exceeds global production. This is expected to continue due to the high barriers of entry into the industry and the increasing popularity of macadamias as a relative new nut being introduced to the world market, as well as the observed increasing global per capita income in middle- to high-income economies. Australia, the USA and China are the major consumers of macadamia nuts, consuming 59 % of global production in 2013.

Between 1996 and 2007, global macadamia prices experienced several downward price cycles. Macadamia prices since 2008 have, however, kept on growing steadily, with no evidence of any looming downward cycle. The main drivers of the ongoing macadamia price increase since 2008 can be ascribed to the continued growth in global consumption, specifically in China and the South East Asian region, and a persistence in lagging production.

The South African Macadamia industry is totally integrated into the global industry and is therefore exposed to all the factors influencing the global industry.
Chapter 4 Structure, Conduct and Performance of the South African Macadamia Industry

4.1 Introduction

In order to facilitate a better understanding of the South African macadamia value chain and the functioning and roles of the different actors in the value chain, a macadamia industry overview is provided. For the purpose of this study, the emphasis of the overview will focus on the structure, conduct and performance of the industry.

4.2 Industry structure

The South African macadamia industry is mainly comprised of macadamia producers and macadamia processors/marketers (PMs). Macadamia PMs include firms that are either exclusively involved in the processing or marketing of nuts, or in the combined activities of growing and processing and marketing of macadamia nuts. The South African industry is built up around the PMs because these firms perform the main share of the industry’s value chain activities. These PMs have developed bulk and/or retail lines of macadamia products, and have established domestic and export markets for these product lines. In addition, these PMs provide research and extension services to growers and develop new macadamia products, as well as markets for existing and new products. Gereffi (2005) stated that value chains are generally characterised by a leading party or parties that determine the overall character of the chain. These leading parties become responsible for upgrading possibilities, knowledge transfer, and integration and coordination within the value chain (Fabe et al., 2009). Governance of the value chain is thus centred at the value chain level where coordination/integration takes place. Coordination/integration can be undertaken by either the buyer (known as buyer-driven value chains) or the producers where they play the key role (known as producer-driven value chains) (Tallec and Bockel, 2005). With the PMs being the leading parties within the value chain, and due to the upstream buying-side oligopsonistic market position PMs hold, it can be concluded that the South African macadamia value chain is buyer driven.
Chapter 4: Structure, conduct and performance of the South African macadamia industry

The macadamia nut industry is formally organised through the Southern African Macadamia Growers’ Association (SAMAC). The association was previously funded by its grower members who paid a voluntary production levy to SAMAC for each kilogram of NIS delivered to SAMAC-registered PMs (SAMAC, 2013). Since November 2014, all macadamia growers are subject to statutory measures including those requiring registration, records and returns on NIS and kernel volumes handled, and related levies, as well as reporting on macadamia tree numbers, both in nursery and infield (NAMC, 2014). The statutory levy is used by SAMAC to finance functions relating to research, technology transfer, provision of industry information, transformation, generic promotion, and industry liaison with government and other bodies, both locally and internationally (NAMC, 2014). SAMAC is also a member of the INC, where it has the opportunity to interact with international macadamia and other key role players within the international nut trade. The South African macadamia industry has a strong private enterprise base with sound governance structures in place, created and funded by growers, processors and marketers (SAMAC, 2013).

4.2.1 The production of South African macadamias

Since the early 1990s, South African commercial macadamia farms have slowly progressed with annual orchard expansion, thanks to research and new cultivar development, but have also been hamstrung by limited capacities of nurseries for providing plant material in large numbers. This process of annual orchard expansion has been ongoing, and as plant material production capabilities of nurseries improved in the late 1990s, new orchard establishment has been accelerated since 2011. Figure 4.1 below shows the respective areas under macadamia orchards for the various provinces, as applicable in 2012. According to SAMAC figures, the total area under macadamia trees in 2012 measured approximately 18 600 hectares, covered by approximately 5.3 million macadamia trees (SAMAC, 2013). Since 2012, the hectares under macadamia cultivation have increased to 21 500 hectares, covered by 6.5 million trees in 2015 (AMS, 2015).
Figure 4.1: Hectares under Macadamia nuts in South Africa during 2012

Source: SAMAC (2012)

Figure 4.2 below relates the hectares under production per province as reflected in Figure 4.1 with the actual and projected volume of NIS equivalent, actually and estimated to be produced by the respective provinces. From the actual and projected DNIS equivalent production volume statistics shown in Figure 4.2, it is clear that Mpumalanga is, and will for the foreseeable future remain, the main contributor to the exponential growth rate of South Africa’s macadamia production. With the bulk of young orchards only starting to produce, or still having to come into production, it is expected that the South African crop will double in volume in the next two to three years (SAMAC, 2013).
Figures 4.3 below presents the total South African macadamia crop (DNIS equivalent) in relation to the global DNIS price over the period 1996 to 2015. From Figure 4.3, it can be seen that South African DNIS equivalent production increased from 3 500 tonnes in 1996 to 46 500 tonnes DNIS in 2015. This is a 1 229 % increase in volume over a 19-year period. During the same period, the global producer price increased from USD 1.86/kg DNIS in 1996 to USD 3.85/kg DNIS in 2014. This represents a 107 % increase over the same 19-year period.

From Figure 4.3, it can be seen that South African macadamia production is encouraged into higher levels of production by increasing global DNIS prices.
Macadamia production in South Africa is concentrated in the hands of approximately 450 farmers, farming on approximately 600 production units located in Limpopo, Mpumalanga, KwaZulu-Natal (KZN) and the Eastern and Southern Cape. Table 4.1 below shows the various formats and related volumes of macadamia nuts produced per province during 2015. In 2015, 49.5% of all South African macadamia plantings were located in Mpumalanga which produced 49.2% of the total kernel volume produced in South Africa.
**Table 4.1:** Macadamia production per province in 2015

<table>
<thead>
<tr>
<th>Processed Macadamia</th>
<th>Limpopo</th>
<th>Mpumalanga</th>
<th>KZN</th>
<th>Eastern Cape</th>
<th>Other</th>
<th>Total RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIS at 10% moisture content (MC) (kg)</td>
<td>14 336 997</td>
<td>25 345 763</td>
<td>8 448 588</td>
<td>1 536 107</td>
<td>1 536 107</td>
<td>51 203 562</td>
</tr>
<tr>
<td>DIS at 1.5% MC (kg)</td>
<td>13 118 353</td>
<td>23 191 373</td>
<td>7 730 458</td>
<td>1 405 538</td>
<td>1 405 538</td>
<td>46 851 259</td>
</tr>
<tr>
<td>Sound Kernel (SK)(kg)</td>
<td>4 460 240</td>
<td>7 885 067</td>
<td>2 628 356</td>
<td>477 883</td>
<td>477 883</td>
<td>15 929 428</td>
</tr>
<tr>
<td>Unsound Kernel (USK)(kg)</td>
<td>437 379</td>
<td>708 496</td>
<td>285 573</td>
<td>47 226</td>
<td>47 226</td>
<td>1 525 900</td>
</tr>
<tr>
<td>Total Kernel (TK)(kg)</td>
<td>4 897 619</td>
<td>8 593 563</td>
<td>2 913 929</td>
<td>525 109</td>
<td>525 109</td>
<td>17 455 328</td>
</tr>
</tbody>
</table>

Source: SAMAC (2015)

Farmers deliver their crops to any of the 17 SAMAC-affiliated PM firms, which are mainly located in Mpumalanga, Limpopo and KZN. A growing number of farmers are achieving GLOBALG.A.P. accreditation and many of the processing/marketing facilities are HACCP and/or ISO 9001 accredited (SAMAC, 2014).

GLOBALG.A.P. is the internationally recognised standard for farm production that translates institutional and consumer requirements into Good Agricultural Practice (GAP). The standard was developed using the Hazard Analysis and Critical Control Points (HACCP) guidelines published by the Food and Agricultural Organization of the United Nations (FAO), and is governed according to the International Organization for Standardisation (ISO) Guide 65 for certification schemes. HACCP is a systematic preventive approach implementing measures that reduce the risks of unsafe food products due to possible biological, chemical, and physical hazards occurring during the production processes reaching the consumer. ISO 9001, on the other hand, is an internationally recognised quality management system that evaluates whether a firm’s quality management system is appropriate and effective for ensuring the delivery of customer expectations and satisfaction on a consistent basis (DAFF, 2012).

The purpose of GLOBALG.A.P and supportive programmes, such as HACCP and ISO 9001, are to ensure, on an international scale, food safety and traceability, the conservation of the environment, workers’ health, and safety and welfare, as well as animal welfare.
4.2.2 The consumption of South African macadamias

Because the South African macadamia industry is export based, with more than 95% of annual production being shipped to international markets, the focus falls on international macadamia consumption trends (SAMAC, 2014).

Per capita macadamia consumption in the major South Africa export destinations, as depicted in Figure 4.4 below, has shown a definite and immediate decline since the global economic crisis in 2008, with the exception of China and the EU.

![Figure 4.4: Per capita kernel equivalent macadamia consumption in major South African export destinations](image)

Source: INC (2014)

As the EU economic crisis deepened with increased problems in the Portuguese, Irish, Italian, Greek and Spanish (PIIGS) economies, the per capita consumption of macadamia nuts also significantly declined in the EU after the latter part of 2011 (AMS, 2015). It is only the per capita consumption of China that has been increasing consistently since 2007.
The contradicting trends of increasing global macadamia consumption versus declining total, as well as per capita, consumption per major South African export destination, can be explained by the following factors (Duncan, 2014):

Increased per capita consumption of macadamias by existing Chinese consumers. A growing number of new middle- to high-income Chinese consumers are entering the macadamia consumer market as first time or regular consumers.

Newly developed export markets and their consumers entering the macadamia consumer market. The entry of South Africa into new developing macadamia NIS and kernel export markets is shown in Figures 4.5 and 4.6 below, respectively.

**Figure 4.5:** Annual growth of South Africa’s macadamia NIS exports to the partner countries between 2012 and 2016

Source: ITC Trade Map (2017)
in favour of NIS imports, while Germany increasingly imports both product formats from South Africa.

Figure 4.6 shows that, other than the USA, Germany, Japan, Hong Kong China, Taipei Chinese and the Netherlands being the main export/consumption destinations for South African macadamia kernel, South Africa also is increasing and diversifying its kernel exports to emerging and existing markets such as Italy, Spain, France, Canada and the United Kingdom. Italy, Spain, France, Canada and the United Kingdom had been progressively increasing their kernel imports from South Africa between 2012 and 2016. Although they are major export destinations for macadamia kernel, the USA, Germany, Japan, Hong Kong China, Taipei Chinese and the Netherlands had been steadily reducing imports from South Africa between 2012 and 2016.
4.2.3 Marketing

Table 4.2 below shows the percentage contributions of South African exports to total global exports during the period from 2011 to 2014. Other major contributors to global macadamia nut exports include Australia and Kenya, which respectively contributed 26% and 8% to global exports in 2014 (DAFF, 2014).

<table>
<thead>
<tr>
<th>Year</th>
<th>South African macadamia exports as percentage share of global macadamia exports</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>36.8</td>
</tr>
<tr>
<td>2012</td>
<td>28.8</td>
</tr>
<tr>
<td>2013</td>
<td>27.8</td>
</tr>
<tr>
<td>2014</td>
<td>31</td>
</tr>
</tbody>
</table>

Source: DAFF (2014)

Before 2008, South African macadamias were only exported in kernel format. After 2008, a NIS market started to develop in South East Asia and specifically in China and Vietnam. Figure 4.7 below shows, measured in NIS equivalent, the South African growth in total macadamia production, as well as the split between the two formats in which the product had been sold on the global market between 1996 and 2015.
The NIS market has been growing steadily, and from 2008 to 2015, volumes increased from 775 tonnes to 19 842 tonnes, which translates into a 2 460 % growth in seven years (SAMAC, 2015). This growth in the NIS market comes at the expense of the kernel market, with less raw product being available for processing into kernel format. In 2015, 42 % of the entire South African macadamia crop was exported as NIS (SAMAC, 2015).

Table 4.3 below presents the data relating to total NIS production between 2008 and 2015 and shows the extent to which NIS exports grew at the expense of raw product processed into kernel. Between 2008 and 2015, the volume of the total South African macadamia crop processed into kernel declined from 96 % to 58 %, while the volume of product made available for NIS sales increased from 4 % to 42 % during the same period.
Table 4.3: Annual South African macadamia crop processing distribution between NIS and kernel format

<table>
<thead>
<tr>
<th>Year</th>
<th>Total NIS produced (Tonnes)</th>
<th>NIS processed into Kernel (Tonnes)</th>
<th>% NIS processed into kernel</th>
<th>NIS Exports (Tonnes)</th>
<th>% NIS exported</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>22008</td>
<td>21233</td>
<td>96</td>
<td>775</td>
<td>4</td>
</tr>
<tr>
<td>2009</td>
<td>24199</td>
<td>21285</td>
<td>88</td>
<td>2914</td>
<td>12</td>
</tr>
<tr>
<td>2010</td>
<td>28328</td>
<td>23907</td>
<td>84</td>
<td>4421</td>
<td>16</td>
</tr>
<tr>
<td>2011</td>
<td>30375</td>
<td>23496</td>
<td>77</td>
<td>6879</td>
<td>23</td>
</tr>
<tr>
<td>2012</td>
<td>34946</td>
<td>26660</td>
<td>76</td>
<td>8286</td>
<td>24</td>
</tr>
<tr>
<td>2013</td>
<td>38800</td>
<td>27000</td>
<td>70</td>
<td>11800</td>
<td>30</td>
</tr>
<tr>
<td>2014</td>
<td>43000</td>
<td>27000</td>
<td>63</td>
<td>16000</td>
<td>37</td>
</tr>
<tr>
<td>2015</td>
<td>46851</td>
<td>27000</td>
<td>58</td>
<td>19842</td>
<td>42</td>
</tr>
</tbody>
</table>

Source: SAMAC (2015)

South African NIS macadamia exports are predominantly made to China, while the balance of the crop is marketed as kernel to various destinations all over the globe. Translating NIS equivalent production and export volumes, as reflected in Figure 4.6 above, into kernel equivalent format allows for a much more detailed representation of macadamia volume export trends to the major South African export destinations. Export volume trends for each destination to which South African macadamia kernel were sold over the period 1997 to 2015 are shown in Figure 4.8 below. From Figure 4.8, it is clear that the USA and Europe have, since 1997, developed into major export destinations for South African macadamia kernel. China has since 2007, as an export destination for South African DNIS macadamias (measured in comparable terms of kernel equivalent volumes), been the fastest developing export destination and largest importer of South African macadamias. Since 2011, South East Asia/Hong Kong has also developed into a major South African export destination.
Figure 4.8: South African kernel equivalent production and exports per destination
Source: SAMAC (2015)

Figure 4.9 below shows South African macadamia kernel equivalent exports as percentages per destinations for 2013. During 2013, Hong Kong, China, was the largest importer of South African macadamias, with 38.1% of the South African crop being exported to the territory (DAFF, 2014). Other countries following on the heels of China as major importers of South African macadamias include the USA (24.5%), the Netherlands (9%) and Vietnam (7.3%). South Africa also exported macadamia nuts to Japan, Germany, Spain, Chinese Taipei and the United Kingdom (DAFF, 2014).
Figure 4.9: South Africa’s macadamia kernel equivalent export percentage per destination in 2013
Source: ITC Trademap (2014)

4.2.4 Gross value of production

The gross production value of South African macadamia nuts will be expressed in kernel equivalent terms in order to create a single and continuous macadamia production value perspective.

Figure 4.10 below shows the gross producer production value, as well as gross wholesale production value (kernel equivalent terms) of macadamia nut quantities, produced in South Africa between 1996 and 2015. During the period from 1996 to 2015, the gross producer production value of macadamia kernel increased from R26 million to R1.271 billion. In nominal terms, this constitutes a growth in gross producer production value of 4 788 % during the last 20 years. This translates into an average annual growth rate of 239 %.
Figure 4.10: Gross producer and wholesale production value of South African macadamia (kernel equivalent terms) produced between 1996 and 2015

Source: SAMAC (2015)

The gross wholesale production value of macadamia kernel increased from R32 million to R1.525 billion over the same period. In nominal terms, this represents a 4 665% growth in 20 years and translates into an average annual growth rate of 233%.

4.2.5 Price trends

The price mechanism refers to the system where the forces of demand and supply determine the price of a commodity and the changes therein. Price thus acts as the principal organising force within a free market economy. It determines what to produce and how much to produce. It determines the rewards of the factor services. It brings about an equitable distribution of income by causing resources to be allocated in the right directions. It works to ration out the existing supplies of goods and services, utilises the economy’s resources fully, and provides the means for economic growth (Mohr & Fourie, 2004).

The ability of price to function as an organising force within a free market economy can, however, be impaired by factors causing the movement of distorted prices up and down the
value chain. Distorted price movement or asymmetric price transmission (APT) – possibly caused by market structure/power (Griffith & Piggot, 1994; Zachariasse & Bunte 2003), adjusting menu costs (Bailey & Brorsen, 1989; Peltzman, 2000), inventory management (Balke, Brown & Yucel, 1998; Reagan & Weitzman, 1982), political intervention (Kinnucan & Forker, 1987; Gardner, 1975) and asymmetric information flow through the value chain – acts rather as a disorganising force than an organising force within a free market economy (Vavra & Goodwin, 2005).

Gaining comprehensive knowledge regarding price information, the forces and factors that in addition to supply and demand influence price formation, and price trends is crucial in order to understand their impacts on the rationing, signalling and incentive function of price, which ultimately have impact on production and marketing decisions (Young & McAuley, 1994). Price transmission in the South African macadamia value chain is analysed in Chapter 5.

South African macadamia producers and PMs are fully integrated into this competitive global macadamia market structure and the associated horizontal and vertical coordination/integration process. Quality standards and regulations, as well as tariff and non-tariff restrictions, which are imposed by the Department of Agriculture, Forestry and Fisheries (DAFF), SAMAC, and certain countries importing South African macadamias, impact on the marketing, trade and trade flow of South African macadamia nuts (DAFF, 2015). On 22 April 2016, DAFF promulgated through the Agricultural Product Standards Act of 1990 specific standards and requirements regarding the export control of in-shell macadamia nuts (DAFF, 2015). On the contrary, the export of macadamia kernel has no formal, legally promulgated product standards and requirements. SAMAC, the handlers of macadamia kernel, are however in agreement and are guided by the quality specifications proposed by the International Nut Council (INC) (SAMAC, 2015). Major importing countries which have imposed tariffs on the import of South African macadamias include Vietnam (30 %) and Japan (5 %) (DAFF, 2015). Under free trade conditions, the price of macadamia nuts is determined by the market forces of demand and supply. Imposed tariff and non-tariff restrictions will, however, distort price formation by impacting on trade flow as well as by artificially inflating product prices in importing countries implementing import tariffs (Radcliff, 2015).
Figure 4.11 below provides some insight into the history of kernel price movements, and the fluctuations in global wholesale USD kernel import price and Rand/USD exchange rate, as well as the impact that these variables have on the nominal Rand wholesale kernel selling price received by PMs, and on the nominal producer kernel price paid by PMs to growers. The average annual South African wholesale kernel price has been determined by converting the USD kernel import price with the applicable Rand/USD exchange rate. The average annual producer kernel price was calculated by deducting the Rand/kg factory processing cost from the average annual South African wholesale kernel price.

![Figure 4.11: History of the average South African macadamia kernel prices from 1996 to 2015](source: SAMAC (2015))

Between 1996 and 2007, the nominal wholesale and producer kernel prices experienced several expanding and contracting cycles. A typical oscillating behaviour between a strong Rand and high USD kernel import price versus a weak Rand and a low USD kernel import price can be observed. The most prominent contracting cycle occurred from 2005 until 2007, during which wholesale and producer kernel prices contracted by 39% and 56%, respectively. Since 2007, both nominal wholesale and producer prices increased strongly on the back of export-
favouring exchange rates, as well as global demand for macadamia kernel continuously outweighing global supply, thus driving prices upwards. A symmetrical trend between the nominal producer and nominal wholesale kernel price is evident from 1996 to 2015.

Figures 4.12 and 4.13 below respectively show the average nominal and real producer prices, as well as nominal and real wholesale prices, for South African kernel since 1996. Both these figures show very similar nominal and real price trends for producer and wholesale kernel prices and only differ to the extent of the per kilogram factory processing cost.

![Nominal and real producer prices for macadamia kernel from 1996 to 2014 (2013 = 100)](image)

**Figure 4.12:** Nominal and real producer prices for macadamia kernel from 1996 to 2014 (2013 = 100)

**Source:** SAMAC (2014)

In conjunction with short-term volatility, a general decreasing trend in real producer and wholesale kernel prices can be observed between 1996 and 2006. A clear growth trend in the real producer and wholesale prices of macadamia kernel can be observed from 2007 onwards. This trend shows no signs of losing intensity and all indications showed a continuation into the 2015 season. In terms of constant purchasing power (real price), the producers in 2014 received all-time high prices for macadamia kernel, exceeding the previously highest prices experienced between 2001 and 2002. Between 1996 and 2007, both the real producer and
wholesale price time series reflect a price cycle (indicated by circles) of moderate intensity, on average spanning a four-year period between consecutive down cycles. Contrary to the four-year price cycle repeating itself in 2011, nominal and real producer and wholesale prices continued to grow strongly into 2014.

Figure 4.13: Nominal and real wholesale prices for macadamia kernel from 1996 to 2014 (2013 = 100)
Source: SAMAC (2014)

Figure 4.14 below shows the nominal producer and nominal wholesale kernel price curves for the period 1996 to 2014. A strong symmetrical trend between the nominal producer price and the nominal wholesale price is visible.
Figure 4.14: Nominal producer price, nominal wholesale price and percentage price gap movement for macadamia kernel from 1996 to 2014

Source: SAMAC (2014)

Figure 4.15 below shows the real producer and real wholesale kernel price curves for the period 1996 to 2014. A symmetrical trend between the real producer and real wholesale kernel prices is evident from 1996 to 2014. When comparing the real producer and wholesale kernel prices (2013 = 100), both show a strong growth trend since 2007. In real terms, the 2014 producer and wholesale prices exceed the previously highest kernel prices received between 2001 and 2002.
Global weather patterns and conditions as experienced in 2014 and 2015 are adversely affecting world tree nut production and worldwide supply to markets. The drought in California, as well as frost and hail storms in Turkey, experienced during 2014 affected almond, pistachio and hazelnut production, and consequently the availability thereof on the global market (AMS, 2015). The drop in supply of three of the world “big five” nuts has placed
upward pressure on almost all nut prices. Hazelnut prices rose by 60% in 2014 to reach a ten-year global high for the product (Duncan, 2014).

In the nut industry, buyers will measure the price they pay for a specific nut relative to what they pay for other tree nuts. Measured against current global almond, pistachio and hazelnut prices, macadamia nuts are becoming more affordable. Based on price, this substitution of other tree nut types in favour of macadamias, as well as the high NIS demand in China and Asia, creates an increased demand for macadamias which ultimately, as in the case of other tree nuts, results in increased prices. Macadamia nut prices have in real terms shown an average increase of 76% per annum for the last six years. Macadamia kernel prices are following prices set by NIS buyers, as kernel users realise that if they want to secure product, they will need to compete with NIS prices from China (Duncan, 2014).

As in the case with all types of tree nut production barriers, the barriers to entry into the primary and secondary macadamia industry relate to capital investment requirements as well as turnaround time before any returns on investment are realised, which are extremely high. The high entry barriers to the macadamia industry and the inability of primary supply to respond to increased demand over the short term is expected to cause supply to continue to lag behind demand, resulting in firm upward pressure on prices (Duncan, 2014).

4.3 The South African macadamia value chain

The following section provides an overview of the South Africa macadamia value chain in terms of the main participants involved. Figure 4.16 below is a representation of the South African macadamia value chain.
Figure 4.16: South African Macadamia value chain
Source: Adapted from DAFF (2015) and SAMAC (2014)

The main value chain participants that will be briefly discussed include the producers, processors/marketers, and the wholesalers/retailer/value-adding sector.
4.3.1 Producers

With high barriers of entry into primary production, production mainly remains concentrated in the hands of existing horizontally integrating macadamia farmers, as well as a limited number of new primary entrants into the industry, who are all spread out over the north-eastern provinces of Limpopo, Mpumalanga, KZN and the Eastern Cape (SAMAC, 2014). The bulk of expansion in macadamia production in terms of area and volumes predominantly emanates from existing farmers expanding primary operations, while very little growth is contributed by new entrants into primary production.

Farming units vary in size, and due to the highly profitable nature of the product, can range from small but profitable lifestyle farms to the largest, which currently approach 1000 hectares planted under macadamia trees. The majority of producers individually do not produce sufficient volumes to justify the time and capital investment involved in processing and market development. These key value chain activities of processing and marketing have been taken on by a few large-enough horizontally integrated individual farmers, or large-enough horizontally coordinated groups of farmers operating in a cooperative business structure (Kuilman, 2010). Because of this, the buying and selling power in a small market like macadamias is concentrated in the hands of a few large PMs that ultimately control the industry value chain. The control of the industry value chain by a few large PMs is not ideal, but without them, the industry value chain would fail (Kuilman, 2010).

Growers have a choice of delivering nuts to any of the 17 SAMAC-affiliated PM plants, most of which are conveniently located in relation to their farms. The location of the farm, relative to the PM plant, is however not the only criteria according to which a producer chooses his most preferred PM. A decision breaker with regard to choice of PM, almost overriding the convenience of the PM’s geographic location, is comprised of the payment terms and conditions in relation to the expeditiousness, as well as number and size, of first to final payments received for deliveries from the PM.

Interactions with macadamia farmers and PMs have indicated that, with the exclusion of producers delivering their crops to PMs operating under a cooperative structure into which they are vertically integrated as shareholders, other producers annually reassess offerings
from different privately owned PMs in terms of price offered, payment terms and conditions, and geographic location before committing to any form of delivery contract. Some growers will make use of multiple privately owned PMs in order to provide them with the opportunity to channel their product to the PMs that consistently meet and exceed the delivery contract terms and conditions agreed upon. This strategy is used by growers to keep privately owned PMs “honest” in their quest to secure consistent and sustainable product flow from an under-supplied product through their businesses.

### 4.3.2 Processors/marketers

Between the late 1960s and the late 1990s, this sector of the South African macadamia industry received very little consideration and consisted of private/single farmer-owned processing plants that performed the complete and very basic processing procedure, covering de-husking, NIS grading, curing, cracking, kernel grading, and packaging. Marketing was the responsibility of an agent or broker who then, for a commission, found buyers and negotiated a price for the product. No governing authority for macadamias existed and commission tariffs were determined between the processors and agents themselves (Van Rooyen, 1999). The processing and marketing operations later demanded development and innovation into higher levels of sophistication as the industry developed and matured over time with regard to increased volumes of nuts produced and improved processing technology, as well as markets and consumer quality standards. This development required investment in customised facilities equipped with, and manned by, highly specialised equipment, machinery and human capital (SAMAC, 2008).

As the processing procedure of macadamias increased in complexity, it demanded substantial capital investment in buildings and the continual expansion and upgrading of specialised equipment. The high capital cost associated with processing plant development and maintenance initially prompted two distinctive development strategies within the processing sector of the industry.

The **first development strategy** involved producers who as individuals became horizontally integrated to such a primary production scale that it enabled them to produce sufficient volumes of nuts that economically justified the investment in the highly sophisticated
processing plants and equipment required for nut processing. This vertically integrated model, in the sole ownership of the large-scale farmer, subsequently attracted and coordinated the produce of smaller-scale primary producers as contract suppliers who on their own could not afford advanced processing equipment and premises. As processing volumes grew, the owners vertically integrated further through some value adding, as well as performing the marketing function in house on an increasingly scale for their own account, as well as for contract suppliers. However, in this vertically coordinated model (VCM), smaller producers remained contract suppliers to the single-owner processing and marketing plant, while relinquishing all post-primary production activities and product control into the hands of the PM.

Traditionally, contract suppliers only got paid for their delivered product after the PM received payment from international or national buyers, and after recovery of all incurred processing and marketing related costs (Duncan, 2014). Due to the highly profitable nature of the macadamia industry and the consequently increasing number of VCM PM firms competing for the limited raw nut supply, favourable payment terms and conditions offered to primary producers have increasingly become a supply procurement securing mechanism (Duncan, 2014). Increased supply procurement from primary producers through the use of contracts, based on favourable supply procurement securing mechanisms, enable the PMs to progress towards a stronger oligopsonistic market position and in this manner control the buying side of the unprocessed nut market. Once established as a buying-side oligopsony, the macadamia PM firm will, due to the protection offered by high entry barriers such as the limited availability of raw material (unprocessed nuts) and the high capital cost of specialised processing machinery and infrastructure, be able to operate as part of an oligopolistic market structure where a few large PMs dominate the processed nut output market (Kuilman, 2010).

Recent developments at PMs involved in this VCM indicate that favourable advanced payment terms alone, as a strategy to attract and secure contract suppliers on a sustainable basis, are not enough (Venter, 2015). Some single-owner PM facilities are in the process of moving away from the VCM and instead moving towards a vertically integrated model by offering contract growers shareholding in processing and marketing facilities. The ebb and flow of unprocessed nut supply from season to season, caused by under supply as well as opportunistic contracted primary producer movement between PMs attributable to ever-
changing seasonal delivery benefits offered by alternative PMs, makes it difficult for users of the VCM to ensure optimal plant operation and committed order fulfilment to buyers of processed nuts (Venter, 2015).

**The second development strategy** involves smaller producers cooperatively establishing, and vertically integrating into, a processing and marketing facility in which they hold ownership through shareholding. This group of producers was prompted towards this vertically integrated model (VIM) by their reluctance to lose control over the physical characteristics and quantities of their NIS product after delivery to a PM facility (Rehber, 2000). As suspected in the case of single-owner VCM PM plants, the lack of clear, honest and transparent communication from PMs regarding the marketing of their product motivated this category of growers to adopt a cooperatively owned and transparently operated PM plant. Their main aim in this is to retain ownership of their product from the farm, through the whole processing operation, to the point of sale to the wholesaler (Kuilman, 2010). In this VIM, the primary producers, according to their shareholding, all share in the costs and profits of the processing and marketing firm, and are obligated as shareholders to deliver all unprocessed nuts for processing and marketing to their processing and marketing firm.

This VIM is based on co-ownership through shareholding and with the associated clear, honest and transparent communication from the PM, as well as favourable payment terms and conditions to producers, has secured consistent and sustainable supply of unprocessed nuts to the PM facility (Duncan, 2015). This model thus allows, through a chosen business structure and the related benefit of shareholding, for the PM to secure consistent and sustainable unprocessed nut supply to a highly specialised and expensive processing plant, while simultaneously allowing for further vertical integration into the value chain. It also ensures dependable processed product flow to the marketing department, which in turn contributes to committed and constant order fulfilment to buyers of processed nuts (Duncan, 2015). PMs using this VIM model have secured a superior and more stable oligopsonistic/oligopolistic market position and related market power, compared with PMs using the VCM strategy.

**A third development strategy** has, as recently as the middle of 2014, started to emerge. This third development strategy is basically a hybrid of the two earlier strategies and consists of a
single-owner PM facility converting into a cooperatively owned processing and marketing facility. In this hybrid model, the original owner retains 50% of the shareholding, with the balance of the remaining shareholding being offered to producers who previously delivered their product under contract to the PM. This model was born out of the need of single-owner PMs to curb VMF (contract failure) and thus opportunistic behaviour by contracted producers who annually required re-contracting (Venter, 2015). The annual re-contracting of producers opens a window of opportunity for primary producers to defect from existing PMs to alternative PMs which offer a better price and payment terms and conditions than those current. By converting to the hybrid model, the single-owner PM hopes to secure loyalty from shareholding producers and thus consistent and sustainable product flow from the limited available raw product. This will enable the PM to run the processing plant at profitable levels, while becoming a reliable and sustainable source of product to the value-adding and wholesale sector of macadamia nuts (Venter, 2015).

In view of the cost savings, all three development strategies resulted in the less crucial and technical aspects of nut processing with regard to pre-grading, curing and storage of NIS being performed on the farm before delivery to the PM for further specialised processing.

The South African macadamia industry is serviced by 17 major PM firms. The four major PM firms handled 71% of the 2015 macadamia crop, as either NIS or processed kernel. Figure 4.17 below, based on 2015 DNIS crop volumes, shows the comparative market shares held by each of the major PM firms within the processing and marketing sector of the industry.
4.3.3 Wholesalers, retailers and value-adding sector

Macadamia kernel mainly finds its way on to the European and USA market as an ingredient in candy and confectionery. Packers of snacking food also roast and flavour macadamia kernel, after which it is packed as part of a nut mix or pure macadamia snack pack destined for the snacking market (Van Schalkwyk, 2015).

NIS is sold mainly to Chinese and Vietnamese traders who pack and distribute the NIS into the Chinese and Vietnamese snacking market (Van Schalkwyk, 2015).

Sound kernel (SK) not suitable for the snacking, candy or confectionery markets is further processed into oil or macadamia butter. Macadamia oil is used as salad dressing or cooking oil or as a base for lotions and creams in the cosmetic industry. Macadamia butter is used as a spread or as a base for pesto and flavouring (AMS, 2015).
Macadamia shells have various applications which include being processed into charcoal briquettes, pressed board wood products, brake linings, and sand blasting agent.

In unprocessed form, macadamia shells are used as mulching in gardens, as well as fuel in the boilers of the macadamia processing plants.

4.3.4 Price formation

A number of industry-unique processes, principles and terminology apply to the South African macadamia industry. In explaining the price formation process of macadamias, it is important to accurately explain the different quality differentiation processes and the related principles and terminology, as well as how all these fit into the process flow of macadamia processing and price formation. A detailed overview of these industry-specific processes, principles and terminology are available in Annexure A.

Figure 4.18 below, in conjunction with Annexure A, shows and explains the macadamia process flow from the farm, through the processing factory, to the final packaged product ready for shipping to predominantly international value adders, wholesalers and retailers. Once a consignment of macadamias has reached the end of the process flow, the quality distribution and attributes of the consignment are known and a quality-based price, as negotiated between the PM (processor/marketer) and the wholesaler/value adder (WVA), can be attached to it. The following sections explain the procedures followed during international and domestic NIS and kernel price formation.
Chapter 4: Structure, conduct and performance of the South African macadamia industry

Figure 4.18: Diagrammatic representation of the original WSP

Source: Adapted from SAMAC Quality Assurance Handbook (2011)
4.3.4.1 International wholesale kernel and NIS price formation

In order to understand the process of international wholesale kernel and NIS price formation, it is important to understand the sequence in which the harvesting and marketing process of South African macadamias takes place during a production year. The harvesting of South African macadamias starts in April and lasts until June. The demand for NIS only starts in October and concludes in December. In contrast to NIS, where demand is concentrated between October and December, the demand for macadamia kernel is spread throughout the year (Van Schalkwyk, 2015).

The process of international wholesale contract and spot-market budget price formation commences in every September of the year preceding that in which a crop is to be harvested. The budget price formation process consists of a pre-season and during-season phase. The pre-season client visitation programme by PMs starts in September and October when the extremely price-sensitive European markets are visited. Chinese clients are visited during November, followed by the US market during the annual Peanut and Tree Nut Processor Association Convention held every January (Van Schalkwyk, 2015).

The purpose of pre-season international client visitation is to refresh and tighten existing client relationships as well as the sourcing and forging of new client contacts. During the pre-season client visitation phase, international markets are assessed with regard to the prevailing economic climate and client sentiments towards future market conditions. Cognisance is taken of remaining client inventory levels, expected demand levels, and client product preferences, as well as price expectations and possible price resistance levels that might lead to product substitution between macadamias and other tree nut types. Owing to global demand consistently outpacing supply, PMs of macadamia kernel are also finely tuned in to possible “panic” orders at higher than usual prices, specifically made by clients who aim to secure adequate volumes of kernel required for sustainable product line manufacturing.

The budgeted international macadamia kernel price, as determined by PMs, is the result of direct negotiations with international clients operating in the various markets, in all of which the assessed price influencing factors have been taken into consideration (Van Schalkwyk, 2015). As previously mentioned, buyers in the international nut industry will measure the
price paid for a specific tree nut relative to what is paid for other comparable tree nuts. The budgeted international contract macadamia kernel price is thus checked for competitiveness against those of other international nut prices. For this purpose, the international pecan and almond prices are used as the top and bottom end price benchmarks, respectively (Duncan, 2015).

Based on the 2015 macadamia, pecan and almond prices, the following benchmarking exercise illustrates the relationship between the budgeted international macadamia price and actual pecan and almond prices.

Due to the difference in edible portion ratios (also known in the industry as the ‘meat ratio’) which exist between pecans, almonds and macadamias, a direct comparison between the various international prices would not result in a fair comparison. The edible portion ratio or meat ratio (MR) refers to the edible portion weight of a nut as a percentage of the total nut weight prior to shelling. At average nut quality, both pecans and almonds have a 50% MR, while macadamias have a 30% MR. Due to its lower MR to pecans and almonds, macadamia must receive approximately a 50/30 or 1.67 times higher price than pecans and almonds to compare on the same MR basis (Van Schalkwyk, 2015). Table 4.5 below reflects how the application of the MR conversion factor and the 2015 international pecan and almond kernel prices are used to calculate benchmark prices for international macadamia kernel prices.

Table 4.5: Calculation of international macadamia benchmark prices from pecan and almonds prices after adjusting for meat ratio differences

<table>
<thead>
<tr>
<th></th>
<th>Bench mark price</th>
<th>Actual USD/kg kernel at 50 % meat ratio</th>
<th>Meat ratio conversion factor</th>
<th>Comparable USD/kg macadamia kernel price adjusted to 50 % meat ratio level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pecan kernel price (2015)</strong></td>
<td>Top benchmark price</td>
<td>12.08</td>
<td>1.67</td>
<td>20.17</td>
</tr>
<tr>
<td><strong>Almond kernel price (2015)</strong></td>
<td>Bottom benchmark price</td>
<td>7.73</td>
<td>1.67</td>
<td>12.91</td>
</tr>
</tbody>
</table>

Source: INC (2015) and own representation

A comparison of the calculated benchmark macadamia kernel prices, as reflected in Table 4.5 above with actual 2015 international macadamia kernel prices as reflected in Table 4.6 below,
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shows a close correlation. This provides confirmation that the budgeted international macadamia kernel prices compare favourably with comparable substitute tree nut products at similar quality and MR levels.

Table 4.6: Average South African per kg price for each macadamia style during the 2015 season

<table>
<thead>
<tr>
<th>Style</th>
<th>USD/kg kernel equivalent @ 1.5 % MC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>19.10</td>
</tr>
<tr>
<td>1</td>
<td>17.90</td>
</tr>
<tr>
<td>S</td>
<td>17.40</td>
</tr>
<tr>
<td>4</td>
<td>15.45</td>
</tr>
<tr>
<td>5</td>
<td>14.50</td>
</tr>
<tr>
<td>6</td>
<td>14.50</td>
</tr>
<tr>
<td>7</td>
<td>10.00</td>
</tr>
<tr>
<td>8</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Source: Mayo Macs (2015)

Contracts and prices for macadamia kernel between PMs and WVAs are normally fixed for a twelve month period in order to ensure sustainable flow of sufficient volumes of kernel into the production facilities of WVAs. This is important to WVAs as it enables them to maintain a consistent supply of their products on to the market. The long-term nature of kernel-related contracts protects PMs from short-term price decreases, but also limits their opportunity to participate in the potential of a rising market. In a rising market, PMs would contract a smaller portion of the expected kernel crop as late as possible in order to benefit from rising kernel prices. If market information and trends indicate a declining market, PMs would resort to contracting a larger portion of the kernel market early in the season (Duncan, 2015). In general, however, PMs only fix contracts for 70% of the expected kernel crop while retaining 30% for marketing at spot market price levels. Following this strategy protects the PMs against possible over contracting, should reduced crop volumes be experienced. It also creates the opportunity for PMs to secure higher than usual spot-market prices resulting from “panic purchases” by WVAs expecting insufficient kernel stock availability later in the season (Van Schalkwyk, 2015).

The international benchmark budget NIS price is initially determined by placing a consignment of NIS on the Chinese market during November in the marketing year. The response time taken by the Chinese WVAs to purchase the test consignment is a good indicator of how
positive or negative the test price is received by them. The price of the test consignment of NIS should at least be equal or better than the price of macadamia kernel of the same quality. Should the NIS be processed into kernel, an SKR factor of 33% would, on average, be recovered. The NIS benchmark price should thus be in the close proximity of 33% of the international benchmark price for kernel. Referring to the 2015 style “S” international kernel price of USD 17.40/kg, the international NIS benchmark price for similar quality should be in the range of USD 5.74/kg (Duncan, 2015). Owing to the current global, and specifically Chinese, market demand outpacing global supply, and WVAs competing fiercely for limited supply, NIS contract prices are as a rule fixed over a shorter term to allow for PMs to assess developing market conditions and thus have the opportunity to share in the potential of a rising price. As in the case of kernel marketing, a healthy portion of the NIS crop is sold on the spot market, not only to prevent over contracting on possible reduced crop volumes, but also to share in the potential of an improving market price (Van Schalkwyk, 2015).

4.3.4.2 Domestic producer price formation

The budgeted international wholesale price, as determined and tested in the market by PMs, provides the basis from which the producer price that the farmers receive is calculated. Definite differences exist in how the producer price paid to farmers is calculated by the different PM models in operation in the South African macadamia industry. Figure 4.19 below provides a representation of the generic process followed by PMs to calculate the producer price paid to the farmer. The final producer prices paid to farmers by PMs are, depending on the applicable PM model in operation, determined by a cluster of factors, or by a combination of several of those factors. These factors include cost and incentive adjustments, such as fixed and variable factory processing costs; NIS drying costs; penalties based and charged for USK content of consignments; statutory levies collected on behalf of SAMAC; storage costs; capital charges; shareholders payments; marketing; and freight and administration costs; as well as farmer incentives such as transport subsidies and delivery volume bonuses.
Figure 4.19: A generic representation of producer price formation
Source: Own representation
Chapter 4: Structure, conduct and performance of the South African macadamia industry

The different approaches followed by each of the PM models to arrive at a final producer price/kg will be discussed separately in the following sections.

### 4.3.4.2.1 Producer price formation in the single-owner, vertically coordinated PM model

Single-owner VCM PM firms annually compete fiercely to secure their share of the limited raw nut supply from contract growers through procurement strategies such as favourable payment terms and conditions, minimal cost structures and incentive schemes including transport subsidies and delivery volume bonuses. PM firms involved in this model believe that maximum first (“voorskot”) payment for consignments, soonest to date of delivery, is the most important factor taken into consideration when contract growers decide on which PM firm they want to deliver their crops to (Sutton, 2015). They also argue that deferred, end of season final (“agterskot”) payments, although nice to receive, are not as an important decision-making factor as immediate, upfront maximum first payments when contract producers have to choose between VCM PM firms (Sutton, 2015).

Based on this perception, single-owner PM firms compete for limited raw nut supply by paying the contract grower a “100 %” producer price, based on a budgeted international wholesale price adjusted for processing costs and delivery incentives. On receiving a higher international wholesale price than that paid to a contract grower, the single-owner PM is under no obligation to share it with the contract grower (Duncan, 2015).

An international wholesale price improvement over the budgeted international price paid to the contract farmer would mainly be used by single-owner PM firms as a following-season contract grower retention/procurement strategy by partially and selectively paying it to contract growers as an end of season bonus payment. Single-owner PM firms also choose to share the ‘bad news’ of during-marketing-season price reductions, and thus reduce payments to contract growers at the end of the season by announcing no final bonus payments, as well as the recovery of any early season over-payments made to contract growers, effected through reduced payments from late-season contract grower deliveries (Duncan, 2015).
4.3.4.2.2 Producer price formation in the cooperatively owned, vertically integrated PM model

In contrast to single-owner PM firms, the cooperatively shareholder-owned PM firms are non-profit focused and function transparently by distributing all surplus nut sales revenue back to its shareholders. This model takes a more conservative approach to determining the final macadamia producer price paid to shareholders. As a rule, 70% of the budgeted international wholesaler macadamia kernel and NIS price, after making provision for recovery of 100% of the factory processing costs, would be paid to the shareholder farmers as first payment. The remaining 30% of the budgeted international wholesaler kernel and NIS price, as well as any benefits of an improvement of the actual international wholesaler price received over the budgeted wholesaler price, is paid out in a number of final ("agtterskot") payments to the shareholders during the closing stages of the season.

4.4 Quantification of the macadamia value chain

The South African, like the global, macadamia industry is extremely young and in a continual state of change with regard to production processes, production regions, areas under cultivation, volumes produced, processing methods, product characteristics and styles, consumer preferences and volumes demanded, marketing and ultimately the value chain structure, chain participants and the various levels of coordination and integration between them. Due to the highly fluid nature of the industry, the macadamia value chain composition and the quantification thereof can show significant changes over the short term. The quantification of the South African macadamia value chain is thus performed on the existing 2015 chain structure and industry information.

The South African macadamia value chain is quantified in Figure 4.20 below. Primary production consists of approximately 450 farmers who farm on 19 000 hectares, planted with 5.9 million macadamia trees of various ages and cultivars. Based on 2015 season yields, approximately 46 851 tonnes DNIS nuts at 1.5% MC were handled by 17 processor/marketing institutions. Ninety-five per cent (44 508 tonnes) of the DNIS crop handled by the 17 processor marketers was channelled to export markets to be sold as either NIS or processed kernel. The remaining 5% found its way, predominantly in kernel format, on to the South African market.
Of the 95% (44 508 tonnes) DNIS delivered at PM firms, 44.6% (19 842 tonnes DNIS) was exported as NIS, while the balance (24 666 tonnes) was processed into 8 388 tonnes SK. The SK was then sold mainly into the US and European markets to candy and confectionery.
manufacturers, as well as packers for the snacking market. The USK component is mainly transformed through a process of cold pressing into macadamia oil. Waste components, such as husks and shells, resulting along the macadamia value chain are respectively utilised as compost/mulch in orchards and fuel for processing plant boilers.

4.5 Conclusion

This chapter creates perspective on the South African macadamia industry structure and the institutional framework, as well as the governance structure on which it is founded. It further provides information about the value chain’s structure, the various value-chain participants involved, the price formation processes, and finally, the quantification of the value chain.

South African macadamia production is concentrated in the eastern areas of Limpopo, Mpumalanga, KZN and the Eastern Cape. In 2015, the total area under macadamia production covered 21 500 hectares, planted with 6.5 million trees which yielded 46 500 tonnes DNIS at 1.5% MC. South African macadamia plantings have since 2015, based on macadamia tree sales from SAMAC registered nurseries, been increasing by approximately 1 500 hectares per year. Forty-two per cent of the 2015 crop was sold as DNIS into the Eastern Asian markets of China and Vietnam, while the remaining 58% of the crop was sold as kernel into the main kernel-consuming markets of the USA and Europe. The South African and global industry has, since 2007, been experiencing exponential growth trends in terms of area under production, yield volumes, and price and value of production. Globally and nationally, the industry shows no immediate sign of slowing down.

The macadamia nut industry is formally organised through the Southern African Macadamia Growers’ Association (SAMAC). The main functions of SAMAC comprise the performance of statutory functions, research, technology transfer, provision of industry information, transformation, generic promotion, and industry liaison with government and other nut industry bodies, both locally and internationally (NAMC, 2014). SAMAC is a member of the INC, where it interacts with international macadamia and various other key role players within the international nut trade.

The South African value chain is very condensed and consists of producers, PMs and WVAs. Barriers to entry to primary production are high, and primary production is concentrated in
the hands of approximately 450 farmers. The processing and marketing of macadamias are performed by 17 PMs who are the leading parties in the value chain responsible for the performance of the core of the industry’s complicated value chain activities, utilising highly specialised and technologically advanced facilities. Because the PMs are the leading parties within the value chain, it can be concluded that the value chain is PM driven and that the governance of the value chain is located at the PM level.

PMs either operate in either a VCM or VIM, both following similar procedures towards attaining wholesale price formation, but with different strategies towards attaining producer price formation. In the VIM, the producer retains ownership of his or her product from the farm gate to the WVA gate, and due to the transparent nature of the model, shares in potential profits emanating at the PM and WVA link in the value chain. In the VCM, the producer relinquishes ownership of his or her product at the PM gate, and is thus not guaranteed to share in any potential profits emanating at the PM and WVA link in the value chain.

Owing to the different approaches followed by VIM and VCM PMs during producer price formation, real potential for asymmetric price transmission exists.
Chapter 5 Market Power and Price Transmission in the South African Macadamia Industry

5.1 Introduction

Most agricultural food chain markets operate under imperfect conditions which cause incomplete price transmission, and thus unfair welfare and profit capturing by middlemen along the value chain (Meyer & von Cramon-Taubadel, 2004; Rapsomanikis et al., 2004).

The South African macadamia market is no exception to this phenomenon. Following the International Macadamia Symposium held in South Africa during 1999, producers have had concerns with regard to vertical APT and welfare distribution along the macadamia value chain. The main concern raised then, and still pertinent to the South African macadamia value chain today, relates to the question as to what extent the situation where there are a few concentrated processors/marketers, who are responsible for the key value-chain activities of buying, processing and selling of macadamia nuts, allows for changes in the global macadamia price to be transmitted to producers situated right at the beginning of the value chain (Vidgen, 1999).

According to Vidgen (1999), the price of macadamia consumer products does not change much. NIS price reductions at producer levels, however, do not reduce consumer prices, but through APT, only generate more money for processors/marketers and/or manufacturers (Vidgen, 1999). Conversely, NIS price increases at consumer level do not consistently lead to producer price increases.

The remainder of this chapter will focus on the different quantitative analysis procedures and models available to investigate the existence of market concentration, market power, and APT, specifically at the producer/processor-marketer (PPM) link of the value chain. Finally, the empirical results emanating from each of the selected test procedures will be interpreted and discussed.
5.2 Data used

For the purpose of this study, the PPM price margin is defined as the difference between the net producer price (PP) – the price paid to the producer by the PM after making provision for all factory-related costs and incentives – and the wholesale price (WP) that the PM received at the factory gate from downstream value adders, wholesaler and retailers. In the context of this study, the PPM price margin thus includes all profits but excludes all costs incurred at the link between the producer and the PM level of the macadamia value chain. Costs typically provided for at this value chain link include:

i. Variable factory costs such as curing/drying costs of nuts up to 1.5% MC, processing costs including grading costs, unsound kernel penalties, packaging, transport and delivery volume incentives/bonuses to primary producers, storage and marketing of unprocessed and processed nuts, and freight costs.

ii. Fixed factory costs including capital charges and administration costs.

iii. Statutory SAMAC levies.

The PP and WP were obtained from two PM sources, respectively representing the VCM and the VIM as depicted in Chapter 4 of this study.

PP and WP, reflecting a combined/pooled average annual PP and WP for 16 vertical coordinated and one vertical integrated model, were obtained from SAMAC. The SAMAC data includes 19 annual observations over a 19-year period from 1996 to 2014. Due to its combined/pooled nature, this PPM price data does not represent a pure, vertically coordinated, nor a pure, vertically integrated, PPM value chain model. This price data is dominated by data contributions from the 16 vertically coordinated PMs and will be utilised as the VCM price data.

PP and WP, reflecting average annual PP and WP for a pure, vertically integrated model, were obtained from Golden Macadamias (GM), a cooperative PM company vertically integrated through shareholding ownership. The GM data includes 14 annual observations over a 14-year period from 2001 to 2014. Henceforth, this data would be utilised as the VIM price data.
Analysing and comparing the VCM price data with VIM price data would provide the opportunity to contrast the influence of the different coordination/integration approaches on price transmission within the South African macadamia value chain.

5.2.1 Data presentation of the nominal and real VCM producer and wholesale prices for DIS macadamia.

Figure 5.1 below presents the nominal VCM PP and WP prices, as well as nominal price margin, for DIS macadamia from 1996 to 2014.

![Figure 5.1: Nominal VCM DIS producer and wholesale prices as well as price margin from 1996 to 2014](image)

Source: SAMAC and own calculations (2016)

Figure 5.2 below presents the real VCM PP and WP, as well as real price margin, for DIS macadamia during the same period.
From Figures 5.1 and 5.2, it is evident that there is an increasing/widening trend in PPM price margins (433% from 1996 to 2014 in nominal terms and 87% in real terms; 23% and 4.6%, respectively, annually). The nominal PP increased by 421% (22% annually) compared with a real PP increase of 83% (4.4% annually) from 1996 to 2014. The WP increased by 423.5% (22.3% annually) and 84% (4.4% annually) in nominal and real terms, respectively, during the same period. On average, the consumer price index (CPI) annually increased by 9.73% during the period, 1996 to 2014.

The producer’s share (Ps) in the WP of DIS macadamia in terms of Rand per kilogram is expressed as:

\[ Ps = \frac{P_p}{W_p} \] ...........................(5.1)

where:

\( P_p \) represents the kilogram DIS producer price at farm-gate level, and
\( W_p \) represents the kilogram DIS wholesale price at factory-gate level.

The long-term producer’s share in the WP varies between a maximum of 81.6\% in 1996 and a minimum of 56\% in 2007, with an average of 74.2\% and a standard deviation of 6.96\% during the period from 1996 to 2014. Although in Figure 5.3 below the price margin in absolute value terms shows a consistent increasing trend between 1996 and 2014, the producer’s share in the WP first decreased between 1996 and 2007, and then increased between 2007 and 2014.

![Figure 5.3: Trends in the price margin and producers’ share in the wholesale prices for DIS macadamia in the VCM from 1996 to 2014](image)

**Source:** SAMAC and own calculations (2016)

Important to keep in mind is the fact that the calculated price margin through the use of the net PP already makes provision for factory-related costs. The observed increase in price margins over time is thus attributable to the provision for factory-related costs within the PP, and is not caused by increasing factory costs incurred, but rather by increasing profits generated at and retained at the PM level in the value chain. This retention of profits at PM
level, subject to the PP price formation policy followed by the PM, causes the WP to increase faster than the PP, thus leading to an increasing price margin. If the increased profits generated at the PM level were transmitted backward to the producer level, the price margin would have shown a decreasing trend.

Between 1996 and 2007, there is a negative correlation between the price margin and the producer’s share in the WP, i.e. an increase in the price margin resulted in a decrease of the producer’s share in the WP. From 2008 until 2014, a positive correlation between the price margin and the producer’s share in the WP exists, i.e. an increase in the price margin resulted in an increase of the producers’ share in the WP.

The producer’s share in the WP showed irregular behavioural patterns over the period 1996 to 2014. The producer’s share in the WP shows a decrease of 31 % from 1996 to 2007 (average annual decrease of 2.6 %) and an increase of 44 % (average annual increase of 5.5 %) from 2007 to 2014.

The long-term real price margin illustrates a relative steady growth pattern over the period 1996 to 2014. The real price margin gradually increased by 87.2 % between 1996 and 2014. The growth in the real price margin translates into an average annual growth of 4.6 % over the 19-year period. However, between 1996 and 2007, the real price margin grew by 75.8 % over a 12-year period (average annual growth of 6.3 %). Between 2007 and 2014, the real price margin increased by 6.4 % over an eight-year period (average annual growth of 0.9 %).

Between 1996 and 2007, the 2.6 % average annual decrease of the producer’s share in the real WP contributed to the 6.3 % average annual growth/widening of the price margin between the real WP and PP. The decrease of the producer’s share in the real WP and the resulting widening of the price margin between the real WP and PP might result from a WP increasing more rapidly than, and at the cost of, the PP.

The 5.5 % average annual increase of the producer share in the WP slowed down the average annual growth/widening of the real price margin between the WP and PP, from 6.3 % per annum over the period 1996 to 2007 to 0.8 % per annum over the period 2007 to 2014.
5.2.2 Data presentation of the nominal and real VIM producer and wholesale prices for DIS macadamia

Figure 5.4 below presents the nominal PP and WP, as well as price margin for NIS macadamia, achieved in the VIM from 2001 to 2014. Figure 5.5 below presents real PP and WP, as well as the price margin, achieved in the same model during the same period. From Figures 5.4 and 5.5, it can be seen that very similar trends exist between the nominal as well as real PP and WP of DIS macadamias processed through the VIM.

The nominal PP increased by 281% (20.1% annually) compared with a real PP increase of 82% (6% annually) from 2001 to 2014. The WP increased by 218.4% (15.6% annually) and 52% (3.7% annually) in nominal and real terms, respectively, during the same period. The CPI increased by 3.7% annually during the period 2001 to 2014.

![Figure 5.4: Nominal VIM DIS producer and wholesale prices as well as price margin as achieved from 2001 to 2014](source: Golden Macadamias and own calculations (2016))
The long-term producer’s share in the WP varies between a minimum of 68 % in 2007 and a maximum of 89 % in 2014, with an average of 78.1 % and a standard deviation of 6.5 % during the period from 2001 to 2014. Figure 5.6 below shows that the price margin in absolute value terms displays a decreasing trend, while the producer’s share in the WP increases over the long term.
As in the case of the VCM, it is also important to keep in mind with the VIM the fact that the calculated price margin, through the use of the net PP, already provides for factory-related costs. The observed decreasing price margin over time, as in the case of the VIM, is caused by the backward transmission of increased profits generated at the PM level to the producer level instead of retaining it, as in the case of the VCM, at the PM level. Subject to the profit distribution policy (level of profit distribution) followed by the PM, the backward transmission of increased profits at the PM level would cause the PP to increase at a faster rate than the WP would, thus causing the price margin between the WP and PP to reduce. Owing to the VIM operating on a non-profitable cooperative principle at PM level, all profits generated at PM level are transmitted backward to the producer level, causing PP to catch up with the WP and thus causing a declining price margin.

There is a negative correlation between the price margin and the producer’s share in the WP, i.e. a decrease in the price margin results in an increase in the producer’s share in the WP.
Although the producer’s share in the WP showed successive increasing and decreasing phases over the period 2001 to 2014, the producer’s share in the WP increased by 19.6% between 2001 and 2014. This translates into an average annual producer share increase of 5.6% in the WP.

Similar to the producer’s share in the WP, the real price margin also showed successive increasing and decreasing phases over the period 2001 to 2014. In contrast with the producer’s share in the WP, the real price margin decreased by 34% between 2001 and 2014. This decrease in real price margin translates into an average annual decrease of 2.4%.

In the VIM, owing to its profit sharing through shareholding characteristics, the 5.6% average annual growth of the producer’s share in the real WP contributes to the 2.4% average annual narrowing of the price margin between the real WP and real PP. The growth of the producer’s share in the real WP and the resulting narrowing of the price margin between the real WP and PP can, owing to the use of a net PP, only result from increased profits generated at the producer and PM value chain link being transmitted backward on to an increasing PP.

5.3 Market concentration and market power analysis

Industry/market concentration refers to the extent to which a small number of firms accounts for a large proportion of economic activity such as total production and sales within an industry (Fedderke & Simbanegavi, 2008). Industry concentration is an important concept when it comes to competition policy debates. This is because it is often argued that industry concentration is a proxy for the market power of firms. The assumption is that high concentration implies that the leading firms have large market shares and thus greater scope for exercising market power by influencing the terms of trade (Tirole, 1988).

This section specifically focuses on alternative quantitative methodologies that can be used to calculate market concentration and/or market power indices to be used as indicators of market concentration and market power.

5.3.1 Methodology used

The literature examining market concentration lists a number of different market concentration measures, namely the Gini and Rosenbluth indices, concentration ratio (CR)
and the Herfindahl-Hirschman Index (HHI), that can be used to measure market concentration (Fedderke & Simbanegavi, 2008). The Gini and Rosenbluth indices, however, are primarily used where there are data limitations. The limitation of these two indices is that they, in the sense of market power, are not very good measures of industry concentration (Fedderke & Simbanegavi, 2008).

The CR and the (HHI) are the most commonly used quantitative measures applied to determine the existence of market concentration and the presence of market power.

5.3.1.1 Concentration ratio

The CR is the percentage of market share owned by the largest/dominant firms in an industry. Market share is a metric used to give a general idea of the size of a firm relative to its market and its competitors. The CR thus indicates whether an industry is comprised of a few large firms or many small firms.

The CR can be expressed as:

\[ CR_m = S_1 + S_2 + S_3 + \cdots + S_m \]

where \( S_m \) = market share of the \( m^{th} \) firm.

If the \( CR_m \) value is close to zero, it would indicate an extremely competitive industry, as the firms included in the \( CR_m \) calculation would not have any significant market share. If the \( CR_1 \) value exceeds 90, that is, one firm controlling more than 90% of the market, the market is effectively a monopoly (Young & McAuley, 1994).

While useful, the CR presents an incomplete picture of the concentration of firms in the industry because, by definition, it does not use the market shares of all the firms in the industry. It also does not provide information about the distribution of firm size. For example, if there were a significant change in the market share among firms included in the ratio, the value of the CR would not change.
5.3.1.2 Herfindahl-Hirschman Index

The HHI is a generally accepted technique that measures the market concentration of an industry’s largest firms in order to determine if the industry is competitive or nearing a monopoly. It is calculated by squaring the market share of each firm competing in a market, and then summing the resulting numbers. The resulting HHI number can range from zero to 10 000.

The HHI can be expressed as follows:

\[HHI = S_1^2 + S_2^2 + S_3^2 + \cdots + S_n^2\]  

where \(S_i\) is the market share of the \(i^{th}\) firm.

The highest possible HHI is 10 000 (a monopoly = 100 per cent). On the low end, a HHI can be extremely small because the index declines with each added market participant. A market with a HHI value below 1 000 is regarded as “un-concentrated,” between 1 000 and 1 800 as “moderately concentrated,” and above 1 800 as “highly concentrated” (Bakucs, Ferto, Hockmann & Perekhozhuk, 2005). The closer a market is to being a monopoly, the higher the market’s concentration (and the lower its competition) is.

5.3.2 Empirical results for market concentration and the existence of market power within the South African macadamia value chain

As seen in Table 5.1 below, the number of macadamia PMs operating in the South African macadamia industry during 2015 amounted to 17. Using PM turnover, as well as tonnes of DNIS marketed by each PM, the single-firm concentration ratio (CR\(_1\)), four-firm concentration ratio (CR\(_4\)), ten-firm concentration ratio (CR\(_{10}\)), and HHI index were calculated. In 2015, the market share of the single largest PM amounted to 26 %. During the same time period, the market share of the four largest and ten largest PMs amounted to 71 % and 92 %, respectively. The CR\(_4\) is the most accepted and commonly used measure of market concentration, and it is used to represent market concentration in this study (Rodgers, 2001). The results from the CR\(_4\) of 71 %, in combination with the calculated HHI index of 1 532, indicate moderate concentration within the South African PM level of the value chain.
Table 5.1: The Concentration Ratio and Herfindahl-Hirschman Index

<table>
<thead>
<tr>
<th>Year</th>
<th>N</th>
<th>CR₁</th>
<th>CR₄</th>
<th>CR₁₀</th>
<th>HHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>17</td>
<td>26</td>
<td>71</td>
<td>92</td>
<td>1532</td>
</tr>
</tbody>
</table>

Source: Own calculations based on collected firm data (2016)

Based on the calculated HHI and CR₄ indexes, the South African macadamia processor/marketers operate in an oligopsonistic market structure (market situation where the presence of few buyers and many suppliers creates a buyer’s market) in which four PM firms have 71% of the macadamia processing market share. This potentially allows PMs to exert a great deal of control over producers, and they could effectively drive down PP and thus the producer share in the WP. PM firms in this oligopsonistic market structure must, however, be very careful in their pricing strategies, as the actions of one firm significantly impact on and influence the others. In the South African value chain context, where PMs compete for limited raw nut supply from primary producers in order to retain and expand their market share in a rapidly growing wholesale market, any price increase offered by a PM to primary producers will result in the loss of raw nut supply to other PMs not following suit.

5.4 Price transmission analysis

The literature review as presented in Chapter 2 of this study extensively discusses the theory of price transmission with regard to the symmetry and asymmetry thereof, the different types of APT, causes of APT, and the implications of APT for value chain participants.

It is evident from various sources in the literature that price transmission in agricultural commodity markets has been examined extensively. The choice between the different possible techniques used in these various studies depends on the questions raised, the data used, and the assumptions made. Many empirical studies were focused on the determinants of retail, wholesale and farm prices, leading authors to use structural models (Vavra & Goodwin, 2005). A number of studies also developed techniques to test the presence and impact of market power with the purpose of providing answers about the possible impact that increased market concentration might have on price adjustment processes (Wohlgenant, 2001).
Meyer and von Cramon-Taubadel (2004) compiled a comprehensive review of APT testing techniques. The review reveals that a long history of asymmetric price studies, based on techniques developed by Tweeten and Quance (1969) and further refined by Wolffram (1971), Houck (1979) and Ward (1981), exists. These techniques involve a regression of price differences on lagged price differences, where the lagged price differences are separated according to sign, so that positive changes are allowed to have a different effect than negative changes. Meyer and von Cramon-Taubadel (2004) refer to these techniques as pre-cointegration techniques. An extensive list of studies in which pre-cointegration price transmission estimation techniques are used exists. Examples include studies of asymmetry in farm-to-retail price transmission in the dairy sector (Kinnucan & Forker, 1987), price asymmetry in the U.S. pork markets (Boyd & Brorsen, 1988) and asymmetric price relationships in the U.S. broiler industry (Bernard & Willet, 1996), to mention but a few.

Recent research has given more careful consideration to the time-series properties of price data. Many economic time series are non-stationary. Stationarity is defined as a characteristic of a process in which the statistical parameters (mean and standard deviations) of the process do not change with time. It follows that the statistical parameters of non-stationary time series or stochastic processes change over time. Non-stationary time series may show trends with regard to its mean or variance. Non-stationary time series typically require transformation, such as differencing or de-trending to make them stationary. In the presence of non-stationary variables, there might be what Granger and Newbold (1974) call spurious regression. A spurious regression appears to have a significant relationship among variables, but the results are in fact without any economic meaning. Thus, testing for non-stationarity and the potential for cointegration relationships among prices at various levels of the value chain have become an important part of price transmission models.

Von Cramon-Taubadel and Fahlbusch (1994) were among the first to incorporate the concept of cointegration into models of APT. They suggest that, in the case of cointegration between non-stationary time series, an error correction model (ECM) extended by the inclusion of asymmetric adjustment terms will provide a more suitable design for the testing for APT. An ECM is a dynamic model in which the movement of the variables in any period is related to the previous period’s deviation from long-run equilibrium. Cointegration provides a method of separating the evolution of time-series data into two components, i.e. the long-run
equilibrium characteristics and the short-run disequilibrium dynamics, using a direct link between cointegration and the ECM. This link is formalised in the Engle Granger Representation Theorem which states that if two series are cointegrated, then an ECM specification would be the most efficient way of representing the long-run and the short-run properties of the system, as well as the nature of the adjustment towards equilibrium. For any set of variables integrated to the first order I(1), error correction and cointegration are identical representations. (Vavra & Goodwin, 2005).

Many researchers have worked on the issue of asymmetric price responses utilising the asymmetric ECM developed by Granger and Lee (1989) or threshold cointegration models proposed by Enders and Granger (1998). Investigating APT between producers and retail markets in South Africa, authors Alemu and Ogundeji in 2010 tested four models, namely Engel-Granger (EG), Threshold Autoregressive (TAR), Momentum Threshold Autoregressive (M-TAR) and Momentum Consistent Autoregressive (MC-TAR) to test for APT, the direction of causation of transmission and the magnitude of transmission, as well as the speed at which the transmission took place. Using model selection criteria, Alemu and Ogundeji (2010) selected MC-TAR as the best model for the purpose.

The following section aims to provide insight into the methodology used to perform the price transmission analysis section of this study.

5.4.1 Methodology used

Price transmission analysis lacks a single, direct and definite empirical testing methodology for important aspects in price transmission analysis, including the determination of time-series stationarity/non-stationarity, and the existence of cointegration of non-stationary time series having the same order of integration as well as causality (Singh, Dey, Laowapong & Bastola, 2015). Addressing these issues is important in order to select the most appropriate regression model for the process of price transmission analysis.

In this study, the Augmented Dickey-Fuller (ADF) (1979) and the Phillips-Perron (PP) (1988) tests will be used to determine time series data stationarity/non-stationarity. The main motive for performing stationary/unit root tests and thus determining the order of integration of the data series is to be able to classify the variables as integrated, stationary,
or perhaps deterministic trend stationary. This will enable the resolving of the long-run and short-run effects in the model, as well as the setting up of an econometric model from which meaningful statistical inferences can be made (Vavra & Goodwin, 2005).

Once the stationarity tests have been performed and non-stationary data transformed to stationary through a differencing procedure, the data series must be tested for co-integration. Depending on the situation, various cointegration tests exist through which cointegration can be determined. The competing procedures for cointegration analysis are the Engle and Granger and Johansen cointegration tests, as well as threshold cointegration models including the TAR, M-TAR, MC-TAR and VAR models. In this study, the Engle and Granger (1987) (used for bivariate analysis), Johansen (1988) (a VAR approach used in multivariate analysis) and Gregory Hansen (1987) (a multivariate extension of the ADF test) procedures will be used to carry out the cointegration and error correction tests. The aim of using different cointegration procedures is to compare the various approaches and choose the best-fitting ECM.

According to Granger’s representation theory, if economic variables are cointegrated, then ECM can be developed to study cointegration relationships. The ECM will examine the responsiveness of one price change to the change in another price at different levels of the value chain, reflecting the correcting ability in terms of speed and magnitude. Finally, the Granger causality (GC) test will be fitted to analyse the direction of influence between the PP and the WP.

5.4.1.1 Stationarity tests

Dickey and Fuller (1979) extended their simple Dickey-Fuller unit root test procedure by including extra lagged terms of the dependent variables with the purpose of eliminating autocorrelation. The lag length on these extra terms is determined by either Akaike Information Criteria (AIC) or Schwartz Bayesian Criterion (SBC). Three possible models of the ADF test, respectively specified to include a constant, a constant and linear trend, or neither in the test regressions, are represented by the following equations:

\[
\Delta y_t = \gamma y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \tag{5.4}
\]

\[
\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \tag{5.5}
\]
\[
\Delta y_t = a_0 + \gamma y_{t-1} + a_2 t + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \tag{5.6}
\]

The difference between the three regressions concerns the presence of the deterministic elements \(a_0\) and \(a_2 t\). The choice of the regression model is important due to the distribution of the test statistic under the null hypothesis differing among the three cases. The null hypothesis of a unit root is rejected if the ADF test statistic is less (lies to the left) of the critical value, and the time series can thus be classified as stationary (Dimitrios & Hall, 2007).

The distribution theory supporting the ADF test is based on the assumption that the error terms are statistically independent and have a constant variance. When making use of the ADF methodology, one has to make sure that the error terms are uncorrelated and that they have a constant variance. Phillips and Perron (1998) developed a generalisation of the ADF test procedure that allows for fairly mild assumptions concerning the distribution errors (Dimitrios & Hall, 2007). The test regression for the PP test is the first order autoregressive AR(1) process, represented by the following equation:

\[
\Delta y_{t-1} = a_0 + \gamma y_{t-1} + e_t \tag{5.7}
\]

While the ADF test corrects for higher order serial correlation by adding lagged difference terms on the right hand side, the PP test makes a correction to the \(t\) statistic of the coefficient \(\gamma\) from the AR(1) regression to account for the serial correlation of \(e_t\). The PP test statistics are thus just modifications of the ADF \(t\) statistics that take into account the less restrictive nature of the error process. As with the ADF test, the PP test can be performed with the inclusion of a constant, a constant and linear trend, or neither, in the test regression. Similar to the ADF test, the null hypothesis of a unit root is rejected if the PP test statistic is less (lies to the left) of the critical value, and the time series can thus be classified as stationary (Dimitrios & Hall, 2007).

Many economic time series, as in the case of the nominal VCM and VIM PP and WP time series as illustrated in Figure 5.1 above and Figure 5.4 above, have an underlying rate of growth, which may or may not be constant. Such series are not stationary as the mean is continually rising. These series are also not integrated, as no amount of differencing, and the subsequent continuous loss of data points through multiple differencing from a limited data series (as in the instance of South African macadamia price data), can make them stationary. This
contributes to one of the main reasons for taking the logarithm of data before using it in any formal econometric analysis. By taking the log of a series, which exhibits an average growth rate, the series will be transformed into a series following a linear trend which is non-stationary and thus integrated (Dimitrios & Hall, 2007).

In this study, the nominal VCM and VIM PP and WP time series data was first log transformed and first differenced before performing the ADF and PP tests to determine the existence of unit-root against the alternative of no unit-root.

5.4.1.2 Cointegration tests

Once the order of integration has been determined, cointegration test(s) need to be investigated. The theory of modelling equilibrium, or the long-run relations of economic variables, was introduced by Granger (1981) as cointegration and analysed by Engle & Granger (1987).

The cointegration of two markets implies that the dynamics of the price relationship in the markets converge in the long term, although they may drift apart in the short term. The importance of estimating the cointegration relationship lies in the revealing of the existence of long-term relationships among non-stationary, integrated variables, and thus avoiding spurious regression analysis (Gujarati, 2003).

5.4.1.2.1 Engle and Granger cointegration test

The Engle and Granger test (EG) (1987) was developed as a simple procedure to test for cointegration, which firstly involves estimating the static cointegration regression using ordinary least squares (OLS), and secondly applying the ADF unit-root test to test the null hypothesis of no cointegration.

Cointegration regression is estimated by simple OLS, using Equation 5.8:

\[ y_t^{producer\ price} = \alpha + \beta_t x_t^{wholesale\ price} + \mu_t \]

\[ \text{...................................................(5.8)} \]

where \( y_t \) is the producer price (PP), \( x_t \) is the wholesale price (WP), and \( \mu_t \) is the residual/error term. Equation 5.8 describes the long-run relationship between series \( y_t \) and \( x_t \). The null
hypothesis of the test is that there is no cointegration relationship between the variables, as against the alternative of cointegration. If the null hypothesis is rejected, the alternative is accepted, implying that the variables are cointegrated in the long run.

The test for cointegration is investigated with the ADF test procedure, as indicated by Equation 5.9:

\[ \Delta \mu_t = \rho \mu_{t-1} + \sum_{i=1}^{n} \lambda_i \Delta \mu_{t-1} + \epsilon_t \] \hspace{1cm} (5.9)

The test for cointegration is equivalent to the ADF test developed for the analysis for unit-root in a single data series, except that here the test is applied to the residuals of the cointegration regression. The critical values for the Dickey-Fuller t-test statistic used to test for cointegration are, however, higher in absolute terms than those used to test the order of integration are.

5.4.1.2.2 Johansen cointegration test

In statistics, the Johansen test is seen as a superior test for cointegration. However, the weakness of the test is that it relies on sample sizes which must be large enough and it is therefore sensitive to specification errors in limited samples.

The Johansen test is a procedure for testing cointegration of several I(1) (non-stationary) time series (Johansen, 1991). This test allows for more than one co-integration relationship and thus is more generally applicable than the EG test which is based on the ADF test for unit-roots in the residuals from a single cointegration relationship (Davidson, 2000).

The Johansen test approaches the testing for cointegration by examining the number of independent linear combinations (k) for a set of \( m \) vectors of variables that yields a stationary process. Cointegration assumes the presence of common non-stationary, i.e. I(1) processes underlying the input time-series variables.

\[ X_{1,t} = \alpha_1 + y_1 Z_{1,t} + y_2 Z_{2,t} + \cdots + y_p Z_{p,t} + \epsilon_{1,t} \]

\[ X_{2,t} = \alpha_2 + \phi_1 Z_{1,t} + \phi_2 Z_{2,t} + \cdots + \phi_p Z_{p,t} + \epsilon_{2,t} \]

\[ X_{m,t} = \alpha_m + \psi_1 Z_{1,t} + \psi_2 Z_{2,t} + \cdots + \psi_p Z_{p,t} + \epsilon_{m,t} \] \hspace{1cm} (5.10)
The number of independent linear combinations \( k \) is related to the assumed number of common non-stationary underlying processes \( p \) as follows:

\[
p = m - k
\]

The following outcomes are plausible:

i. \( k = 0, p = m \). In this case, the time-series variables are not cointegrated.

ii. \( 0 < k < m, 0 < p < m \). In this case, the time-series variables are cointegrated.

iii. \( k = m, p = 0 \). All time-series variables are stationary (I(0)). Cointegration is not relevant here.

The examining of the number of independent combinations indirectly results in the examining of the cointegration hypothesis.

The Johansen test has two test methods: the trace test and the maximum eigenvalue test. Both tests address the cointegration hypothesis, but each asks different questions.

The trace test examines the number of linear combinations (i.e. \( K \)) to be equal to a given \( (K_0) \), and the alternative hypothesis for \( K \) to be greater than \( (K_0) \) where;

\[
H_0: K = K_0
\]

\[
H_0: K > K_0
\]

To test for the existence of cointegration using the trace test set \( (K_0) = 0 \) (no integration), and examine whether the null hypothesis can be rejected. If this is the case, the conclusion is that there is at least one cointegration relationship.

The maximum eigenvalue test asks the same question as the Johansen test. The difference is an alternative hypothesis.

\[
H_0: K = K_0
\]

\[
H_0: K = K_0 + 1
\]
Using $K_0 = 0$ and rejecting the null hypothesis implies that there is only one possible combination of the non-stationary variables to yield a stationary process (Sjo, 2008).

A significant weakness of the EG and Johansen test methodologies is their implicit assumption that the system makes symmetric adjustments towards equilibrium. If adjustment is asymmetric, the estimated equation could be incorrectly specified. Based on these weaknesses, Enders and Granger (1987a) and Enders and Siklos (2001) suggested the use of threshold adjusted models. These models account for the asymmetric price transmission prevalent in most vertically integrated markets.

### 5.4.1.2.3 Gregory and Hansen cointegration test

It is important to note that the Engle and Granger and Johansen cointegration tests do not allow for structural breaks in the sample period, whether for level (intercept) shifts or regime (intercept and slope) shifts. According to Gregory and Hansen (G-H) (1996), the power of the EG (1987) test of the null hypothesis of no cointegration is substantially reduced in the presence of a break in the cointegration relationship. To solve this problem, G-H extended the EG test to allow for breaks in either the intercept or the intercept and trend of the cointegration relationship at an unknown time. The G-H cointegration test thus allows for the testing of the null of no cointegration of variables with I(1) order in the presence of structural breaks in the cointegration relationship.

In the G-H test, there are four different models for the analysis of structural change in the cointegration relationship. These models are: i) level shift, $C$; ii) level shift with trend, $C/T$; iii) regime shift where both intercept and slope coefficient change, $C/S$; and iv) regime shift where intercept, slope coefficient and trend change, $C/S/T$ (Olusengun, Abimbola & Oluwatosin, 2012). The four models of G-H with assumptions about structural breaks and their specifications with two variables, for simplicity, are as follows:

The four G-H models based on the assumptions of structural breaks in the cointegration relationship can for simplicity with two variables be stated as follows:

**Model 1: Standard cointegration**

\[ Y_t = \mu_1 + \alpha_1 X_t + e_t \] \hspace{1cm} \text{(5.11)}
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Model 2: Cointegration with level shift (CC)

\[ Y_t = \mu_1 + \mu_2 \varphi_{tk} + \alpha_1 X_t + e_t \] ...............................................................(5.12)

Model 3: Cointegration with level shift and trend (CT)

\[ Y_t = \mu_1 + \mu_2 \varphi_{tk} + \beta_1 t + \alpha_1 X_t + e_t \] ...............................................................(5.13)

Model 4: Cointegration with regime shift (CS)

\[ Y_t = \mu_1 + \mu_2 \varphi_{tk} + \alpha_1 X_t + \alpha_2 X_t \varphi_{tk} + e_t \] ...............................................................(5.14)

where:

\( Y \) is the dependent variable

\( X \) is the independent variable

\( t \) is time subscript

\( e \) is the error term

\( k \) is the break in date and

\( \varphi \) is a dummy variable such that:

\[ \varphi_{tk} = \begin{cases} 0, & \text{av } t \leq k \text{ (k is the breaking point)} \\ 1, & \text{av } t > k \end{cases} \]

G-H constructed three statistics for the four tests, namely the ADF, \( Z_\alpha \) and \( Z_t \). These statistics correspond to the traditional ADF test and Phillips type test of unit-root on the residuals. The G-H approach tests the null hypothesis of no cointegration with structural breaks against the alternative of cointegration. Gregory and Hansen tabulated critical values by modifying the Mackinnon procedure. The null hypothesis is rejected if the ADF, \( Z_\alpha \) and \( Z_t \) statistic is smaller than the corresponding critical value (Dritsakis, 2012).
5.4.1.3 Engle and Granger two step ECM estimation model

The first step in the Engle and Granger two-step ECM estimation model is to estimate the static cointegration regression by simple OLS using Equation 5.8. If cointegration is confirmed, then Equation 5.8 describes the long-run relationship between series \( Y_t \) and \( X_t \).

In the second step, the residuals saved from the OLS first step estimation of the long-run equilibrium are used in the error correction model

\[
\Delta y_t = \left( \rho \Delta x_t + \omega v^\wedge_{t-1} + e_t \right) \tag{5.15}
\]

where \( v^\wedge_{t-1} = (y_{t-1} - \alpha^\wedge - \beta^\wedge_{t-1}) \).

5.4.1.4 Granger causation

Granger (1981) argued that causality in economics could be tested for by measuring the ability to predict the future value of a time series using prior values of another time series. The Granger causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another. Thus, when a time series \( X \) Granger-causes a time series \( Y \), the patterns in \( X \) are approximately repeated in \( Y \) after some time lag. Past values of \( X \) can then be used for the prediction of future values of \( Y \) (Singh et al., 2015).

Granger defined the causality relationship based on two principles:

i. The cause happens prior to its affect.

ii. The cause has unique information about the future values of its affect.

The first step in running the test is to state the Null hypothesis and alternative hypothesis:

H(0): \( y_t \) does not Granger-cause \( X_t \)

H(a): \( y_t \) Granger-causes \( X_t \)

The second step in performing the test is finding the f-value by using Equations 5.16 and 5.17.

Equation 5.16 can be used to determine whether \( X_t \) Granger-causes \( Y_t \):

\[
y_t = \sum_{i=1}^{\infty} \alpha_i y(t - i) + c_1 + v_1(t) \tag{5.16}
\]
Similarly, Equation 5.17 can be used to determine whether \( y_t \) Granger-causes \( x_t \):

\[
x_t = \sum_{i=1}^{\infty} \alpha_i x(t-i) + c_1 + v_1(t) \]

To conclude the test, the null hypothesis must be either rejected or accepted by comparing the f-value with the F-statistic. The null hypothesis is rejected if the F-statistic is greater than the f-value.

Running both these tests can yield four possible outcomes. The four possible outcomes include no Granger causality, one-way Granger causality in either direction, or with Granger causality running in both directions.

5.4.2 Empirical results for price transmission analysis in the South African macadamia value chain

The results are discussed in the following order. Firstly, the order of integration of the data is determined. Secondly, the co-integration results are presented. Thirdly, the estimates of the adjustment mechanisms (error correction) in the producer/processor-marketer NIS market channels are given. Finally, the causality test results for the existence of, and the direction of, causation are discussed.

5.4.2.1 Stationarity test

The stationarity test results for the PP and WP series as applicable to the VIM and VCM are discussed in the following sections, respectively.

5.4.2.1.1 Stationarity tests for VIM PP and WP series

The results of the ADF and PP unit-root tests conducted on the VIM PP and WP series for the three alternative models are presented in Table 5.2 below, first at logarithmic levels and then for log first differences. The null hypothesis for this is the existence of a unit-root (non-stationary), with the alternative of no unit-root. In the ADF test, the maximum lag length allowed for was three, and was determined automatically and based on the simple interval calculation method (SIC). In the PP test, the lag truncations for the Bartlett kernel were chosen automatically according to the Newey and West suggestions.
Table 5.2: ADF- and PP tests for unit root in the PP and WP series of the VIM

<table>
<thead>
<tr>
<th>Series</th>
<th>ADF</th>
<th></th>
<th>Critical value (95 %)</th>
<th>Prob.</th>
<th>Log length</th>
<th>ADF statistic</th>
<th>Critical value (95 %)</th>
<th>Prob.</th>
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<td></td>
<td>Model</td>
<td>Lag length</td>
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<td></td>
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<td></td>
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</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Producer price (PROD)</td>
<td>Constant</td>
<td>0</td>
<td>0.480</td>
<td>-2.86</td>
<td>0.978</td>
<td>-2.947*</td>
<td>-2.86</td>
<td>0.066</td>
</tr>
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<td>Wholesale price (WHOLE)</td>
<td>Constant</td>
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<td>0.808</td>
<td>-2.86</td>
<td>0.989</td>
<td>-2.623</td>
<td>-2.86</td>
<td>0.113</td>
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<td>Producer price (PROD)</td>
<td>Constant and linear trend</td>
<td>0</td>
<td>-0.944</td>
<td>-3.41</td>
<td>0.919</td>
<td>1</td>
<td>-2.951</td>
<td>-3.41</td>
</tr>
<tr>
<td>Wholesale price (WHOLE)</td>
<td>Constant and linear trend</td>
<td>0</td>
<td>-0.714</td>
<td>-3.41</td>
<td>0.949</td>
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<td>-3.569*</td>
<td>-3.41</td>
</tr>
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<td>1.837</td>
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<td>0.977</td>
<td>-2.509*</td>
<td>-1.94</td>
<td>0.016</td>
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<td>0</td>
<td>2.114</td>
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<td>0.989</td>
<td>-2.166*</td>
<td>-1.94</td>
<td>0.033</td>
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<td><strong>Log first difference</strong></td>
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<td>Producer price (PROD)</td>
<td>Constant</td>
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<td>0.694</td>
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<td>0.986</td>
<td>-2.907*</td>
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<td>Wholesale price (WHOLE)</td>
<td>Constant</td>
<td>5</td>
<td>1.262</td>
<td>-2.86</td>
<td>0.996</td>
<td>-2.632</td>
<td>-2.86</td>
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<td>Producer price (PROD)</td>
<td>Constant and linear trend</td>
<td>3</td>
<td>-0.817</td>
<td>-3.41</td>
<td>0.937</td>
<td>12</td>
<td>-4.848*</td>
<td>-3.41</td>
</tr>
<tr>
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<td>Constant and linear trend</td>
<td>4</td>
<td>-0.470</td>
<td>-3.41</td>
<td>0.970</td>
<td>12</td>
<td>-4.701*</td>
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<td>None</td>
<td>3</td>
<td>1.927</td>
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<td>-2.463*</td>
<td>-1.94</td>
<td>0.018</td>
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<td>None</td>
<td>2</td>
<td>2.105</td>
<td>-1.94</td>
<td>0.988</td>
<td>-2.167*</td>
<td>-1.94</td>
<td>0.033</td>
</tr>
</tbody>
</table>

Notes: * Denotes significance at the 5 % level and the rejection of the null hypothesis of non-stationary. Critical values are taken from MacKinnon (1991).

The results of the ADF test performed at logarithm levels indicate that both the PP and WP series are non-stationary for all three test regression models. The results of the ADF test performed at log first difference levels for the test regression model, including no constant and trend, indicate however that the PP and WP data series is stationary at log first difference and thus I(1).

The results of the PP test performed at logarithm levels indicate that both the PP and WP are non-stationary for all three test regression models. The results of the PP test performed at log first difference levels for the test regression models, excluding a constant and trend or including a constant and trend, indicate however that the PP and WP data series is stationary at log first difference and thus I(1).

5.4.2.1.2 Stationarity tests for VCM PP and WP series

Similarly to the VIM, the results of the ADF and PP unit-root test conducted on the VCM PP and WP series, firstly at logarithm levels and then at log first differences for the three alternative models, are presented in Table 5.3 below. The null hypothesis for this analysis is the existence of a unit-root (non-stationary), with the alternative of no unit-root. As in the case of the stationarity tests for the VIM PP and WP series, the maximum lag length allowed
for in the ADF test was three and was determined automatically and based on SIC, while the lag truncations for the Bartlett kernel in PP test were chosen automatically according to the Newey and West suggestions.

Table 5.3: ADFt and PPt for unit root in the PP and WP series of the VCM

<table>
<thead>
<tr>
<th>Series</th>
<th>Model</th>
<th>ADF Lag length</th>
<th>ADF statistic</th>
<th>Critical value (95%)</th>
<th>Prob.</th>
<th>Log first difference</th>
</tr>
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<td>Logarithm level</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Producer price (PROD)</td>
<td>Constant</td>
<td>0</td>
<td>0.203</td>
<td>-2.86</td>
<td>0.965</td>
<td>-3.373 *</td>
</tr>
<tr>
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<td></td>
<td>-2.86</td>
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<td></td>
<td>0.026</td>
</tr>
<tr>
<td>Wholesale price (WHOLE)</td>
<td>Constant</td>
<td>0</td>
<td>0.457</td>
<td>-2.86</td>
<td>0.980</td>
<td>-3.323 *</td>
</tr>
<tr>
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<td></td>
<td>0.029</td>
</tr>
<tr>
<td>Producer price (PROD)</td>
<td>Constant and linear trend</td>
<td>0</td>
<td>-1.110</td>
<td>-3.41</td>
<td>0.900</td>
<td>-3.590 *</td>
</tr>
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<td>0.975</td>
<td>-3.100 *</td>
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<td>0</td>
<td>2.460</td>
<td>-1.94</td>
<td>0.994</td>
<td>-2.814 *</td>
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<td></td>
<td>-1.94</td>
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<th>Phillips-Perron Bandwidth</th>
<th>PP test statistic</th>
<th>Critical value (95%)</th>
<th>Prob.</th>
<th>Bandwidth</th>
<th>PP test statistic</th>
<th>Critical value (95%)</th>
<th>Prob.</th>
<th>Log first difference</th>
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<tr>
<td>Producer price (PROD)</td>
<td>Constant</td>
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<td>0.203</td>
<td>-2.86</td>
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<td>-2.86</td>
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<tr>
<td>Wholesale price (WHOLE)</td>
<td>Constant</td>
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<td>0.457</td>
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<td>0.980</td>
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<tr>
<td>Producer price (PROD)</td>
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<td>-3.590</td>
<td>-3.41</td>
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<tr>
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<tr>
<td>Producer price (PROD)</td>
<td>None</td>
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<td>1.738</td>
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<td>-3.100</td>
<td>-1.94</td>
<td>0.004</td>
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</tr>
<tr>
<td>Wholesale price (WHOLE)</td>
<td>None</td>
<td>0</td>
<td>2.460</td>
<td>-1.94</td>
<td>0.994</td>
<td>1</td>
<td>-2.823</td>
<td>-1.94</td>
<td>0.008</td>
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</tbody>
</table>

Notes: * Denotes significance at the 5 % level and the rejection of the null hypothesis of non-stationary. Critical values are taken from MacKinnon (1991).

The results of the ADF test performed at logarithm levels indicate that both the PP and WP series are non-stationary for all three test regression models. The results of the ADF test performed at log first difference levels for all three alternative test regression models in all cases indicate that the PP and WP data series is stationary at log first difference and thus I(1).

The results of the PP test performed at logarithm levels indicate that both the PP and WP are non-stationary for all three test regression models. The results of the PP test performed at log first difference levels for all three alternative test regression models in all cases indicate that the PP and WP data series is stationary at log first difference and thus I(1).

In conclusion, it can be said that, based on the PP test performed at log first difference levels for the test regression model including a constant and linear trend, both the PP and WP data series of the VCM and VIM are stationary at log first differences and thus I(1).
5.4.2.2 Co-integration test

The objective of the cointegration test is to determine the existence of a long-term relationship between the linear combination of producer prices (PP) and wholesale prices (WP). If producer and wholesale prices move together in the long run, price transmission is symmetrical. When prices do not move together, price transmission is asymmetrical and an in-depth analysis regarding the nature of price adjustments back to equilibrium position becomes imperative.

In this study, the Engle and Granger (1987), Johansen (1988) and Gregory Hansen procedures were used to carry out the cointegration tests. Although the Johansen and Gregory Hansen (1996) tests are seen as superior tests for cointegration, they both rely on sample sizes which are large enough and, in the case of this study, had to be abandoned owing to the data limitations not allowing for any results from which significant inferences and conclusions could be made.

For the purpose of this study, the Engle and Granger procedure was thus used for cointegration analysis of the PP and WP in the test regression model, including both a constant and trend. With this study focusing on vertical integration in the macadamia value chain, the existence of market concentration and market power at the processor/marketer level, and the impact thereof on price transmission from the WP to the PP, the remaining statistical tests for cointegration, error correction and Granger causality were performed with the WP stated as the independent variable and the PP as the dependent variable.

5.4.2.2.1 Engle and Granger test for cointegration between the PP and WP of the VCM

The Engle and Granger (1987) cointegration test was performed by first fitting the long-run Equation 5.8, where, $Y$ and $X$ represent the PP and the WP of NIS macadamias, respectively.

The least square estimates of the regression for NIS macadamia, with the independent variable being the WP and the dependent variable being the PP, reflect as follows:

$$Y = -0.43009 + 1.0461X_t + \mu_t$$

...(5.18)
The t-statistic and the p-value for the intercept and slope are -3.4177 (0.0031) and 24.3805 (0.000), respectively.

Next, the cointegration test for the least square regression was performed with ADF Equation 5.9.

In the cointegration test of the regression, with the WP being the independent variable, the estimated value of $\rho$ is 0.0673, while the t-statistic for the null hypothesis of no cointegration is -1.8128.

The test critical values for 1%, 5% and 10% significance levels are -2.6924, -1.9602 and -1.6071, respectively. It can be seen from these critical values that the null hypothesis is rejected at 1% level of significance. This is because the value of the t-statistic is smaller (lies to the left) than the tabulated critical value of 1%. The result indicates that the PP and WP are cointegrated, i.e. they share a certain type of behaviour in terms of their long-term fluctuations. The coefficient of the WP, stated as the independent variable, is a long-run coefficient and significant.

5.4.2.2 Engle and Granger test for cointegration between the PP and WP of the VIM

The Engle and Granger (1987) test for cointegration was repeated to test for cointegration between the PP and WP of the VIM.

The least square estimates of the regression for NIS macadamia, with the independent variable being the WP and the dependent variable being the PP, reflect as follows:

\[
Y = -0.767 + 1.166X_t + \mu_t
\]

The t-statistic and the p-value for the intercept and slope are -11.1889 (0.0000) and 54.6851 (0.000), respectively.

Next, the cointegration test for both the least square regressions was performed with ADF Equation 5.9.
In the cointegration test of the regression, with the WP being the independent variable, the estimated value of ρ is 0.0001, while the t-statistic for the null hypothesis of no cointegration is -4.9506.

The test critical values for 1%, 5% and 10% significance levels are -2.6924, -1.9602 and -1.6071, respectively. It can be seen from these critical values that the null hypothesis is rejected at 1%, 5% and 10% levels of significance. This is because the values of the respective t-statistics are smaller (lies to the left) than the tabulated critical values of 1%, 5% and 10%. The result indicates that the PP and WP are cointegrated, i.e. they share a certain type of behaviour in terms of their long-term fluctuations. The coefficient of the WP, stated as the independent variable, is a long-run coefficient and significant.

5.4.2.3 Error correction

With the cointegration relationship between the PP and WP of the VCM and VIM being confirmed in Sections 5.4.2.2.1 and 5.4.2.2.2, the cointegration prerequisite to proceed with the ECM has been met. The ECM for the WP, stated as the independent variable and the PP as the dependent variable for the VCM and VIM, will be discussed in the following sections.

5.4.2.3.1 Error correction model for the VCM

Table 5.4 below reflects the ECM output for the WP stated as the independent variable and the PP as the dependent variable. All coefficients in Table 5.4 are individually statistically significant at 1% level. The following inferences can be made about the short- and long-run influences of the WP as independent variable on the PP as dependent variable. In the short run, the WP coefficient of 1.26 shows that a 1% increase in the WP will lead to a 1.26% increase in the PP. In the long run, the WP coefficient of 1.046 as reflected in the cointegration regression Equation 5.18 shows that a 1% increase in the WP will, on average, lead to a 1.046% increase in the PP.
The significant difference between the short-run and long-run independent variable (WP) coefficients indicate short-run volatility in the WP requiring substantial levels of correction between the short-run and long-run PP in order for the PP to approach equilibrium.

The coefficient of the error correction term of approximately -0.20 suggests that 20% of the discrepancy between the long-term and short-term PP is corrected within a year (annual data), suggesting a slow and partial rate of adjustment to equilibrium.

With the error correction term representing the level of dependent variable adjustment back to equilibrium attributable to a change in the independent variable, it can be concluded that in order to have symmetric price transmission between value chain levels, i.e. from the PM to the producer, the related error correction term must have a value of 1, indicating a 100% transmission in price change from the WP to the PP. The error correction term of 0.20 indicates a 20% transmission in price change from the WP to the PP, thus leading to partial transmission/APT in the VCM.

5.4.2.3.2. Error correction model for the VIM

Table 5.5 below reflects the ECM output for the WP stated as the independent variable and the PP as the dependent variable.

All coefficients in Table 5.5 are individually statistically significant at 1% level. The following inferences can be made with regard to the short- and long-run influences of the WP as independent variable on the PP as dependent variable. In the short run, the WP coefficient of
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1.16 shows that a 1% increase in the WP will lead to a 1.16% increase in the PP. In the long run, the WP coefficient of 1.17 as reflected in the cointegration regression equation in Equation 5.19 shows that a 1% increase in the WP will, on average, lead to a 1.17% increase in the PP.

Table 5.5: ECM of log differenced PP and WP in the VIM

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std.Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
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<tbody>
<tr>
<td>D(LNWHOLE)</td>
<td>1.1552</td>
<td>0.0604</td>
<td>19.1211</td>
<td>0.0000</td>
</tr>
<tr>
<td>RESID_PROD(-1)</td>
<td>-1.3399</td>
<td>0.3132</td>
<td>-4.2784</td>
<td>0.0013</td>
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</table>

The small difference between the short-run and long-run independent variable (WP) coefficients indicates short-run stability in the WP requiring minimal levels of correction between the short-run and long-run PP in order for the PP to approach equilibrium.

The coefficient of the error correction term of -1.34 suggests that 134% of the discrepancy between the long-term and short-term PP is corrected within a year (annual data), suggesting a slow but complete rate of adjustment to equilibrium. The error correction term of 1.34 indicates a 134% transmission in price change from the WP to the PP, thus leading to complete/symmetrical price transmission (SPT) in the VIM.

Using the ECM test output results to compare the VCM and the VIM for their respective price change responsiveness in terms of speed and magnitude of adjustment, the following conclusions can be drawn:

i. The ECM coefficients of the VCM and VIM with the WP stated as the independent variable show that the discrepancy correction between the long-term and short-term PP of the VCM is only partial at 20%, while complete at 134% in the case of the VIM.

ii. Asymmetric price transmission between the producer and PM level of the value chain is evident in the VCM.
iii. Symmetric price transmission between the producer and PM level of the value chain is evident in the VIM.

iv. The discrepancy correction between the long-term and short-term PP of both the VCM and VIM occur within a one-year period.

v. Although the rate of discrepancy correction takes place within a one-year period in both the VCM and VIM, the VIM is superior in its ability to accommodate magnitude discrepancy corrections between the PP and WP.

### 5.4.2.4 Pair-wise Granger causality test

The Granger (1969) causality test was performed to determine the causal direction of information flow between variables and to identify whether causality runs from the wholesaler to the producer (Y → X) or vice versa (the arrow indicates the direction of causality). The Granger causality test was used to test the null hypothesis stating that the WP does not cause the PP, and that the PP does not Granger-cause the WP. Granger causality test results can be either un-directional (the PP and WP have no influence on each other), unidirectional (influence flows one way), or bidirectional (influence in both directions).

Tables 5.6 and 5.7, below, respectively show the Granger causality test results for the VCM and VIM.
Table 5.6: Granger causality test results for the VCM

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLNWHOLE does not Granger Cause DLINPROD</td>
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<td>0.3572</td>
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<td>DLINPROD does not Granger cause DLNWHOLE</td>
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Granger causality test with 2 lags

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
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<td>17</td>
<td>0.4503</td>
<td>0.6478</td>
</tr>
<tr>
<td>DLINPROD does not Granger cause DLNWHOLE</td>
<td>0.4407</td>
<td>0.6536</td>
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</tbody>
</table>

Source: Eviews output

Table 5.7: Granger causality test results for the VIM

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<th>Null Hypothesis</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
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</thead>
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<td>0.68344</td>
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<td>DLINPROD does not Granger cause DLNWHOLE</td>
<td>0.04769</td>
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Granger causality test with 2 lags

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<thead>
<tr>
<th>Null Hypothesis</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.4695</td>
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<tr>
<td>DLINPROD does not Granger cause DLNWHOLE</td>
<td>0.31121</td>
<td>0.7422</td>
<td></td>
</tr>
</tbody>
</table>

Source: Eviews output

The Granger Causality test results for both the VCM and VIM show that neither the PP nor WP Granger-causes the WP or PP. The coefficients of the PP and WP have no effect on the future WP and PP, and as such, provide no other information for predicting the future of the WP or PP. There is thus not sufficient evidence from the test results for the existence of unidirectional or bidirectional causality in either the VCM or VIM. With the existence of unidirectional causality in both the VCM and VIM, there is thus basically no flow of information in the market leaving the PP and WP without having any influence on one another.
5.5 Conclusion

South African macadamia price margins have, over time, been increasing in real terms in the VCM, while decreasing in the VIM. In the VCM, the producer’s share in the wholesale price shows a declining long-term trend. Within the long-term declining trend of the producer’s share in the wholesale price, a distinctive short-term increasing trend following on an initial decreasing trend can be observed. The VIM, however, in contrast to the VCM, shows a constant long- and short-run increasing trend in the producer’s share in the wholesale price.

To understand the various trends of the price margins, related to the VCM and VIM, it is crucial to understand the functioning of the South African macadamia value chain, as well as the different manners in which the VCM and VIM operate.

The South African macadamia industry consists of approximately 450 producers who produce macadamias on an estimated 600 production units, spread out over the eastern regions of the Limpopo, Mpumalanga, KZN and Eastern Cape provinces. The producers have the choice to supply their product to any of the existing 17 PMs, following either one of the two basic business models, i.e. a VCM or a VIM, existing in the industry. Using PM turnover, as well as tonnes of DNIS marketed by each PM, the calculated four-firm concentration ratio (CR₄) and HHI index indicate moderate concentration at the PM level of the value chain, with the four largest PM controlling 71% of the processing market share. Producers supplying nuts to a PM following a vertically coordinated business model (VCM) do so as contract producers who relinquish ownership of their product at the factory gate, and therefore do not, as a rule, share in any profits generated by the PM after selling processed nuts to the wholesale and value-adding sector of the value chain.

Producers supplying nuts to a PM following a vertically integrated business model (VIM) do so as cooperative-shareholding owners of the processing and marketing facility and, through the retention of product ownership beyond the factory gate, share in profits generated up to the processor/marketer and Wholesale/Value adder link of the value chain. It is due to the basic differences between the processors and marketers, following either the VCM or VIM (i.e. point of ownership change on product delivery to the PM as well as the alternative profit sharing policy), that opposite long-term trend behaviours (i.e. VCM showing a long-term...
increasing price margin, while the VIM shows a long-term decreasing price margin) in the price margins can be observed.

Cointegration was found in both the producer price (PP) and wholesale price (WP) for macadamias in both the VCM and VIM. This confirms that the PP and WP of each individual model share a certain type of behaviour in terms of their long-term fluctuations. It is critical to establish the nature of this relationship in terms of how prices are transmitted through the VCM and VIM value chains. The analysis performed on the WP/PP relationship of the VCM shows that price transmission is asymmetric. This implies that a change in price at the PM level of the value chain does not fully transmit backward to the producer level of the value chain. Alternatively, the analysis performed on the WP/PP relationship of the VIM shows that price transmission is symmetric. This implies that a change in price at PM level actually fully transmits backward to the producer level of the value chain. There is thus proof of symmetry in magnitude and speed of price transmission in the value chain of the VIM, while asymmetry in magnitude and speed of price transmission exists in the value chain of the VCM.

The causality test performed in this study shows the existence of un-directional causality in both the VCM and VIM. There is thus basically no flow of information in the market leaving the PP and WP without having any influence on one another. Although the causality test showed that the PP and WP do not influence one another, the current situation of demand exceeding supply contributes to a change in the WP being transmitted backward to the PP. In order for PMs to secure limited available nut supply from producers, PMs are forced to transmit profits to producers in order to stay competitive with regard to pricing in the procurement process. This is clearly illustrated in the case of PMs following the VCM. Processor/marketers using the VCM, since the development of the NIS market in 2008, have had to increasingly backward transmit profits to their contract producers in order to prevent producer defection and related nut supply loss to competing PMs that might offer increased prices to attract additional nut supply from limited stock.

From the literature review (Section 2.6.3), it is clear that APT is prevalent in food product markets. There are numerous possible reasons for APT, including menu costs, inventory costs, transaction costs, the fear of price wars, concentration and market power at a specific value
Chapter 5: Market power and price transmission in the South African macadamia industry

chain level (non-competitive imperfect markets), asymmetric information flow, product homogeneity and differentiation, exchange rates, and border and domestic policies.

With moderate levels of concentration and market power being identified (see Section 5.3.2) at the PM level of the macadamia value chain, the potential for APT exists. The potential for market power to become a cause of APT at the PM/producer value chain link is, however, neutralised by PMs having to compete for limited nut supply from producers. Although PMs are in a position with potential market power, the need to compete for limited nut supplies from producers forces PMs to progressively backward transmit price increases to producers in order to have a chance to secure a viable portion of limited nut supply. With a market structure supporting a position of market power for PMs in general, but neutralised by under-supply and over-demand trends, existing APT between the PM and producer in the VCM can rather uniquely be attributed to the business model followed by PMs in the VCM. APT in the VCM is caused by PMs only partially backward transmitting increases in WP to producers, up to the point where they can retain their position of securing sufficient volumes of the limited nut supply from producers. Once the situation of continuous under supply of nuts from producers has been resolved through increasing production volumes, PMs using the VCM will no longer have to backward transmit profits to producers, as they (PMs) will no longer have to compete for the limited supply from producers. The benefit of being involved in a VIM, with associated symmetric price transmission benefits attributable to its business model characteristics, will only become evident to producers involved in a VCM under conditions of oversupply.
Chapter 6 Summary, Conclusions and Recommendations

6.1 Introduction

The global, as well as the South African, macadamia industry started with commercial primary production activity and focused processing and marketing initiatives in the mid-1940s and 1960s, respectively, and finds itself in transition between the late introductory and early growth phase of the product lifecycle. Finding itself in the early phases of the product lifecycle, the macadamia industry is typified by dynamic and continually changing value chain and market structures. These changing value chain and market structures are mainly the result of a growing number of industry role players who, through vertical coordination and integration strategies, endeavour to secure, gain and maintain a competitive position and market share. This dynamic nature of the macadamia value chain and market structure contributes to VMF, which presents the industry with the prominent challenge of understanding how vertical coordination and integration:

- can lead to the development of organised and stable value chain and market structures,
- might contribute to rational and predictable market behaviour, while also
- potentially initiating the creation of excessive market concentration and market power, and thus
- impact on the symmetry of price transmission up and down the value chain with regard to magnitude, speed, nature and direction.

Addressing this challenge requires a firm and comprehensive understanding of the fundamental dynamics of the industry in order to (i) understand the value chain in detail, (ii) identify the challenges that the industry faces and which limit its efficient functioning, (iii) create among stakeholders the awareness and understanding of the dynamic forces at work within the industry, which would assist them to position themselves better with regard to profitability and competitiveness within the industry value chain, and (iv) guide decision making in the public and private sector domains.
Compiling an extended outline of the macadamia industry and the environment it operates within will not provide sufficient information to facilitate the understanding of the fundamentals of the industry. In order to make any normative judgements regarding the performance of the macadamia industry, a comprehensive value chain analysis is required. This study was conducted through the use of value chain analysis, and concentration ratio and price transmission analysis, which was structured to achieve a thorough understanding of the macadamia industry and thus allow for normative performance measurement.

6.2 Objectives of the study

This study firstly aimed to map, quantify and analyse the South African macadamia value chain; secondly, to determine the extent of vertical integration and coordination within the value chain; thirdly; to identify concentration levels and thus the existence of market power created through vertical integration and coordination between the different value chain linkages; and lastly, to determine and understand how market power is impacting on the magnitude, speed, nature and direction of price transmission within the macadamia value chain.

To achieve the above objectives, the following were addressed:

- The structure, conduct and performance of the South African macadamia value chain was investigated by conducting a comprehensive industry analysis, focusing on the South African macadamia industry structure, and the institutional framework and governance structure on which it is founded. An industry analysis was performed to provide information about the value chain structure, the various value chain participants involved, price formation processes, and finally, for the purpose of quantifying the value chain;

- The macadamia value chain was, through the use of various techniques including concentration ratios as well as Gini, Rosenbluth and Herfindahl-Hirschman indices, evaluated for the possible existence of market concentration and market power.

- Through the application of various, and the selection of the most appropriate of, regression models suited for price transmission analysis, it was determined how market power impacts on the magnitude, speed, and direction of price transmission within the macadamia value chain.
Finally, a comparative study was compiled to compare the impact of market power on price transmission within the alternative macadamia value chain models as found in the South African macadamia value chain.

6.3 Summary

The purpose of this section is to give a brief synopsis of the complete study. In order to create a holistic perspective, the summary will focus on:

- The literature study as contained in Chapter 2;
- pertinent issues observed regarding the structure, conduct and performance of the global and South African macadamia industry, and;
- research findings concerning the existence of market concentration and market power within the South African Macadamia industry, and the impact thereof on price transmission between the producer and PM levels of the value chain.

6.3.1 Pertinent aspects from the literature study

The literature review focused on the theoretical background of all concepts and theories relevant to this study. The literature review starts off with a review of the value chain concept and the importance of VCA. This was followed up with a review of the VCA methodologies suitable for analysing the South African macadamia value chain. Next, the concepts of vertical coordination and integration, as well as the motives for vertical coordination and integration, were reviewed. The final section of the literature review focused on price transmission along the agro-food chain, asymmetric price transmission (APT) and the various types of asymmetry, the causes of APT, and finally, the implications of APT.

The importance of VCA lies in various reasons, but in view of this study, the most important reason why VCA is important lies in the fact that it helps to explain the distribution of welfare benefits, particularly profits, to those participating in the value chain. The concept of VCA originates from two definite lines of thought, i.e. the French filière concept and Wallerstein’s concept of commodity chains. Over the years, these two approaches have evolved into various derivative methods for VCA. During the review of the different methods of VCA, a “golden thread” of commonalities, originating from the French filière concept and Wallerstein’s concept of commodity chains, became apparent. Irrespective of the observed
commonalities, each of the derived VCA approaches differentiates itself from the next by possessing a unique and specific analysis procedure ideally suited for the analysis step at hand. The VCA analysis procedure followed in this study is thus a combination of various analysis procedures which is selected for its suitability from the different VCA approaches reviewed. Central and common to the different VCA methodologies reviewed, is the core activity of value chain mapping. Value chain mapping provides a method to view the food system framework as a cross section of a vertically linked chain of production and the transformation and marketing activities that shift an agricultural commodity from the farm through the value chain to consumers. Mapping a value chain thus assists with gaining a clear understanding of the order of activities and the key actors and relationships involved in the value chain.

The quantification of the value chain requires the adding of quantitative data to the various value chain linkages and related actors participating in value chain activities. Subject to VCA requirements, the quantitative data added can include all or selected data elements pertaining to the number and size/capacity of actors at each level of the value chain, physical flows of commodities along the value chain, financial flows, gross and net output values, and destination of sales, as well as information flows within the value chain.

The abovementioned list of quantitative data elements is not exhaustive and can be expanded to facilitate the performance evaluation of the value chain. Conducting an accurate and relevant performance evaluation of the value chain is important and depends heavily on the acquisition of reliable and accurate data and statistics regarding the sector under investigation.

In reviewing the concepts of, and motives for, vertical coordination and integration, it became apparent that agriculture has, since the time of primitive agriculture, evolved from a fully integrated system to a gradually disintegrated system where different levels of the value chain specialise in specific value chain activities. As in the case of primitive agriculture, modern advanced agriculture is, however, showing a strong tendency to move away from disintegration back to vertical coordination and integration. The motive for modern agriculture to progress through the different levels of open production to vertical coordination, and then to vertical integration, can be found in the integrator’s desire to gain
control over the various value chain activities and levels of the value chain. The integrator’s desire for control over value chain activities and different value chain levels are in turn driven by the integrator’s aversion to risk and affinity for improving efficiency, reducing costs and creating market power (Rehber, 2007).

Price transmission studies are useful and important, as they provide understanding as to how, in terms of speed, direction and magnitude, product price changes in one market are transmitted vertically to another, and as to what role profit-seeking value chain participants play in this regard. They also provide knowledge about the extent of market integration, as well as about which markets function efficiently. Of special interest in price transmission studies, is the occurrence of APT between agricultural value chain levels. Numerous price transmission studies conducted in agricultural value chains have found that APT is the rule rather than the exception, and that APT is widespread in the majority of agricultural product markets. Although ATP has several possible causes, the existence of imperfect competition and thus of market power is recognised as the main cause of APT. For whatever reason the existence of APT within the value chain, it will, subject to the specific situation, impact either favourably or negatively on value chain participants. Under APT conditions, a favourable impact on one value chain participant will at some point have a negative welfare impact on other upstream or downstream value chain participants. The main concern with APT is the magnitude and term of the welfare impact that it exercises on value chain participants, i.e. the community.

6.3.2 Structure, Conduct and Performance of the global and South African macadamia industry

This study provides a Structure, Conduct and Performance analysis and overview of the global and South African Macadamia industry that assesses the latest trends in global and South African macadamia production, consumption, marketing, production values and prices.

Global macadamia industry results show that macadamia production only contributes 1.2% of total tree nut volumes produced. Production is concentrated in the hands of South Africa and Australia. Being an expensive nut, consumption of macadamias is mainly located in middle- to high-income economies. The global supply and demand for macadamias is finely
balanced, and demand regularly exceeds supply, which contributes to rising prices and production value. This status quo is expected to remain in place due to the inelasticity of supply caused by high barriers to entry into primary production, as well as the rapid increase in demand attributable to the popularity of the nut. Australia, the USA and China are the largest consumers of macadamia nuts. Macadamia nuts find their way on to the global market in either kernel or NIS format, where it is predominantly packed for, and consumed by, the snacking market. Although global macadamia production volumes have been increasing steadily throughout its commercial production history, prices and production values had, prior to 2007, experienced several expanding and contracting cycles. Since 2007, prices and production values have, notwithstanding the fact of rapidly growing production volumes, displayed continuous exponential growth.

South African macadamia production is mainly concentrated in the hands of approximately 450 farmers, predominantly located in the eastern lying regions of the Limpopo, Mpumalanga and KwaZulu-Natal provinces. It is estimated that existing plantings are expanding at a rate of 1 500 hectares per year. Producers deliver their product to any of the 17 existing processors/marketers (PMs) who process and market the nuts in either kernel or NIS format. The processing and marketing sector of the value chain is concentrated in the hands of four dominant PMs who control 71% of processing and marketing. Macadamia kernel is sold into the European and American market, while NIS is sold into the South East Asian, and specifically the Chinese and Vietnamese, markets. With the South African macadamia industry being fully integrated into the global industry, it shows similar production volume, price and production value trends as observed in the global context.

The South African macadamia value chain is condensed and the main actors in the value chain consist of the producers, PMs, and wholesalers/value adders. With high barriers to entry into primary production, production mainly remains concentrated in the hands of the existing horizontally integrated macadamia farmers, as well as a limited number of new primary entrants into the industry. Expansion in macadamia production in terms of area and volumes predominantly originates from existing farmers expanding their primary operations, while very little growth is contributed by new entrants into primary production. Farming units vary in size, and due to the highly profitable nature of the product, can range from small but
profitable lifestyle farms to the largest that currently approach 1 000 hectares planted under macadamia trees.

Processors/marketers operate in a buying-side oligopsonistic and selling-side oligopolistic market structure, employing either a vertically coordinated or a vertically integrated business model. Because the PMs are the leading parties within the value chain, it can be concluded that the value chain is PM driven and that the governance of the value chain is located at the PM level.

In excess of 95% of the annual South African macadamia crop is exported to the European, American, Chinese and Vietnamese markets in either kernel or NIS format, predominantly for consumption in the snacking market and to a lesser extent for use as ingredients in candy and confectionery products.

Buyers in the international nut industry will measure the price paid for a specific tree nut, relative to what is paid for other comparable tree nuts. The budgeted international contract macadamia kernel price is thus determined by using the international pecan and almond price to establish a comparative top and bottom end benchmark wholesale price for macadamia nuts. These international benchmark wholesale prices for macadamia nuts, as determined by PMs, provide the basis from which the producer price the farmers receives is calculated. Definite differences exist, however, in how the producer prices paid to farmers are calculated by the different PM models in operation in the South African macadamia industry. The final producer prices paid to farmers by PMs are, depending on the applicable PM model in operation, determined by a cluster of factors, or by a combination of those factors, including cost and incentive adjustments such as fixed and variable factory processing costs, NIS drying costs, penalties based and charged for USK content of consignments, statutory levies collected on behalf of SAMAC, storage costs, capital charges, shareholders payments, marketing, and freight and administration costs, as well as farmer incentives such as transport subsidies and delivery volume bonuses.

6.3.3 Market concentration and market power in the macadamia value chain

Market concentration refers to the extent to which a small number of firms account for a large proportion of economic activity, such as total production and sales within an industry.
Chapter 6: Summary, conclusions and recommendations

The assumption is that high concentration implies that the leading firms have large market shares and thus greater scope for exercising market power by influencing the terms of trade. Based on this argument, market concentration is accepted as a proxy for the market power possessed by firms. Although various methods exist for the determination of the extent of market concentration that exists within an industry, only two approaches, namely the CR and the HHI index, were found to be suitable in the context of this study.

Using PM turnover, as well as tonnes of DNIS marketed by each of the existing 17 PMs, the single-firm concentration ratio \( (CR_1) \), the four-firm concentration ratio \( (CR_4) \) and the ten-firm concentration ratio \( (CR_{10}) \), as well as HHI index, were calculated. In 2015, the market share of the single largest PM amounted to 26%. During the same time period, the market shares of the four largest and ten largest PMs measured 71% and 92%, respectively. The \( CR_4 \) is the most accepted and commonly used measure of market concentration, and it is used to represent market concentration in this study. The \( CR_4 \) result of 71%, in combination with the calculated HHI index of 1 532, indicates moderate concentration within the South African PM level of the value chain, which potentially allows PMs to exert some level of control over producers.

### 6.3.4 Price transmission

Finding moderate levels of market concentration and market power existing at the PM level of the value chain, and thus potential existing for PMs to exert some level of control over producers, it becomes important to analyse how price changes at PM level are transmitted backward to the producer.

Price transmission analysis lacks a single, direct and definite empirical testing methodology for important aspects in price transmission analysis, including the determination of time-series stationarity/non-stationarity, and the existence of cointegration of non-stationary time series having the same order of integration as well as causality. Addressing these issues is important in order to select the most appropriate regression model for the process of price transmission analysis. Several econometric modelling techniques suited for price transmission analysis were considered and the most appropriate model was chosen based on several criteria.
For the purpose of this study, the PPM price margin is defined as the difference between the net producer price (PP), i.e. the price paid to the producer by the PM after making provision for all factory related costs and incentives, and the wholesale price (WP) the PM received at the factory gate from downstream value adders, wholesaler and retailers. In the context of this study, the PPM price margin thus includes all profits but excludes all costs incurred at the link between the producer and the PM level of the macadamia value chain. This analysis found that the real price margin in the VCM increased over time, while the real price margin in the VIM decreased over time.

The increase in price margin as observed in the VCM is, due to the provision for factory related costs within the PP, not caused by increasing factory costs incurred, but rather by increasing profits generated and retained at the PM level of the value chain. This retention of profits at PM level, subject to the PP price formation policy, followed by the PM causes the WP to increase faster than the PP, thus leading to an increasing price margin. If the increased profits generated at the PM level were transmitted backward to the producer level, the price margin would have shown a decreasing trend. This argument is confirmed and supported by the long-term declining trend shown by the producer share in the WP.

As in the case of the VCM, the price margin applicable to the VIM through the use of the net PP already provides for factory-related costs. The decreasing price margin as observed in the VIM is caused by the backward transmission of increased profits generated at the PM level to the producer level instead of retaining them, as in the case of the VCM, at the PM level. Subject to the profit distribution policy (level of profit distribution) followed by the PM, the backward transmission of increased profits at the PM level would cause the PP to increase at a faster rate than the WP does, thus causing the price margin between the WP and PP to decrease. Because the VIM operates on a non-profitable cooperative principle at PM level, all profits generated at PM level are transmitted backward to the producer level, causing the PP to catch up with the WP and thus cause a declining price margin. This argument is confirmed and supported by the long-term increasing trend shown by the producer share in the WP.

Cointegration was found in both the producer price (PP) and wholesale price (WP) for macadamias in both the VCM and VIM models. This confirms that the PP and WP of each individual model share a certain type of behaviour in terms of their long-term fluctuations. It
is critical to establish the nature of this relationship in terms of how prices are transmitted through the VCM and VIM value chains, respectively. The analysis performed on the WP/PP relationship of the VCM shows that price transmission is asymmetric. This implies that a change in price at the PM level of the value chain does not fully transmit backward to the producer level of the value chain. Alternatively, the analysis performed on the WP/PP relationship of the VIM shows that price transmission is symmetric. This implies that a change in price at PM level actually fully transmits backward to the producer level of the value chain. There is thus proof of symmetry in magnitude and speed of price transmission in the value chain of the VIM, while asymmetry in magnitude and speed of price transmission exists in the value chain of the VCM.

The causality test performed in this study shows the existence of un-directional causality in both the VCM and VIM. There is thus basically no flow of information in the market leaving the PP and WP without having any influence on one another.

6.4 Conclusion

From the literature study, it is clear that the competitive consequences of vertical integration are determined by the nature of upstream and downstream market structures. Amongst the most important elements of market structure is the market power that a business possesses within an industry, creating the ability to set a product price without reducing profits or losing market share, as well as its ability to shut competitors out of a market. Market power usually is a result of industry concentration, product differentiation and cost advantages. Industry concentration emanates from the progressive elimination and replacement of contracts as chain coordination and governance mechanisms with vertical integration of successive value chain activities, thus leading to the establishing of increased market control and power in the hands of the integrator. Lasting market power that generates above-normal profits is protected by barriers to entry which preserve above-normal profits through the prevention of entry of new entrants into a specific industry. Businesses not only get involved in vertical integration to increase the level of market power at one link of the value chain, but also to increase market power throughout each successive value chain link.
After conducting a comparison of the South African macadamia value chain characteristics of market structure, concentration/integration, and power, as well as the barriers to entry protecting value chain positions with market power, against literature study content, it becomes clear that macadamia PMs possess all the attributes required to exercise market power, up and down the value chain. Market power abuse in the form of APT is thus expected to be prevalent in all formats of the South African macadamia value chain.

With moderate levels of concentration and market power being identified and confirmed at the PM level of the macadamia value chain, the potential for APT well and truly exists. The potential of market power to cause APT at the PM/producer value chain link is, however, neutralised by PMs having to compete for the limited nut supply available from producers. Being in a position with potential market power, but having to compete for limited nut supply from producers, forces PMs to progressively backward transmit price increases to producers in order to gain a chance to secure a viable portion of limited nut supply. With a market structure supporting a position of market power for PMs in general, but neutralised by under-supply and over-demand trends, the existing APT between the PM and producer in the VCM can rather uniquely be attributed to the business model followed by PMs in the VCM. Asymmetric price transmission in the VCM is caused by PMs only partially backward transmitting increases in WP to producers, up to the point where they can retain their position of securing sufficient volumes of the limited nut supply from producers. Once the position of continual undersupply of nuts from producers has been resolved through increasing production volumes, PMs using the VCM no longer have to transmit profits backward to producers, as they (PMs) will no longer have to compete for the limited supply from producers.

Market structures which emerge as a result of vertical coordination and integration are favourable to the establishment of market power which might manifest itself in the form of APT. However, this can be totally neutralised by supply and demand patterns, i.e. demand consistently exceeding supply, as well as by the business model followed by the firm operating at the value chain link where market power is located.
6.5 Recommendations

Recommendations made to the industry are based on, and presented in, the context of research topics addressed in, and related to results from, this study.

6.5.1 Vertical coordination/integration

Vertical integration of producers, through shareholding ownership in the processing and marketing level of the value chain as applied in the VIM, is beneficial for both producers and the PMs. In this system, the producers are shareholders in a transparent processing and marketing setup, and are therefore constantly aware and assured of the symmetric transmission of any positive or negative price changes. This transparent system provides no reason for any producer to defect to other PMs. Because producers are shareholder owners of the processing and marketing facility, PMs are assured of a constant product flow into the processing and marketing facility that allows for optimal infrastructure utilisation and predictable product flow estimation, which contributes to reliable and sustainable client order fulfilment.

Vertical coordination through contracting into the processing and marketing level of the value chain, as applied in the VCM, displays aspects that can be harmful to both producers and PMs. In the VCM, the producer relinquishes ownership of his or her product at the processing and marketing facility gate and has no further knowledge of, or benefits from, improved wholesale prices realised by the PM. This opaque system creates suspicion among producers with regard to market power abuse by PMs, which was originally the reason why producers resorted to vertical integration into processing and marketing facilities. Contract producers involved in this system have low levels of loyalty towards PMs and are easily lured away by alternative PMs. The uncertainty of sustainable producer retention, and thus product delivery, exposes VCM PMs to inconsistent volumes of product flows into their plants. This contributes to the intermittent under-utilisation of infrastructure, as well as uncertainty about reliable product availability that is essential to long-term client relationship building based on constant and reliable client order fulfilment. The constant search for recruiting and contracting of new and existing producers contributes to PM transaction costs, thus increasing total costs and impacting negatively on the producer price finally realised by the producer.
Viewed from the opposing vertical integration and vertical coordination perspectives, it is advisable for PMs following the VCM to consider the implementation of the hybrid processing and marketing model of offering producers shareholding in the processing and marketing facility, while retaining equal or majority shareholding. Following this strategy will contribute to transparency regarding the price formation and transmission process between the PM and the producers, create confidence and trust, prevent producer defection and thus secure sustainable quality product flow into processing and marketing facilities which will facilitate optimal PM plant utilisation and consistent and reliable WVA order fulfilment. All of this can contribute to brand building and the establishment of a reliable client base, through which long-term off-take relationships can be developed.

6.5.2 Market power

The associated VIM characteristics of loyal, producer-owned processing and marketing facilities contribute to reliable and predictable volumes of quality product flowing through the processing and marketing facilities, optimum processing plant infrastructure utilisation, and dependable client order fulfilment. This leads to sustainable long-term client relationship building which creates a competitive advantage position and consequently a position with market power for the followers of the VIM approach. The market power created in this processing and marketing model mainly lies within its ability, through consistent supply of quality products, to meet the product needs of an established WVA client base while being able to keep transactions costs to a minimum.

In contrast with the VIM, the followers of the VCM approach enjoy a position of market power, limited to a situation where nut supply exceeds demand. In a situation of supply exceeding demand, VCM PMs have ample access to nut supply from producers and thus only need to backward transmit increases in wholesale prices to the point where it has secured sufficient product needed for client order fulfilment. This position of market power is totally neutralised under circumstances where nut demand exceeds supply, as VCM PMs will progressively have to backward transmit wholesale price increases to opportunistic producers in order to secure sufficient product required for client order fulfilment. The existence of VIM PMs characterised by their non-profitability approach, and thus symmetric backward transmission of wholesale price increases to owner producers, allows a benchmark price to
be created, against which producers delivering to VCM PMs can measure their prices received. The existence of a VIM-created benchmark price tends to, through comparison, eliminate the minor market power position that VCM PMs enjoy during periods when nut supply exceeds demand. The market power associated with the VCM PM model mainly lies within its ability to gain unfair rents from its contract producers during periods when supply exceed demand.

Viewed from opposing market power perspectives, it is clear that should VIM PMs wish to expand their producer client base, and by virtue of their superior market power position emanating mainly from their favourable transaction cost position, they would be able to do so by influencing terms of trade, i.e. by setting the price for a product without reducing profits or losing market share, thus shutting competitors (VCM PMs) out of the market. To gain an equal competitive position, it is advisable for VCM PMs to adopt either a pure or hybrid VIM approach.

6.5.3 Price transmission

History has shown that producers which deliver their product to a PM following a VCM will, under conditions of short supply, be less exposed to APT because these PMs will have to progressively backward transmit price increases to producers in order to secure sufficient product volumes required to fulfil WVA orders. However, under conditions of oversupply, PMs following the VCM will have access to an unrestricted supply from producers and would no longer have to backward transmit price increases to producers as part of their procurement strategy. With looming increases in production volumes and possible over-supply conditions given slow market development, it is advisable for producers delivering to a PM following a VCM approach to consider supplying their product to PMs following the VIM approach. This study confirmed that producers who deliver their product to a PM following the VIM approach, in which they retain ownership of their product up to the point of sale to WVA and thus share in higher prices through shareholding ownership, are not exposed to abusive market power resulting in APT.
6.5.4 Market development

As a young industry, both the global and South African macadamia industries find themselves in transition between the late introductory and early growth phase of the product lifecycle. Contrary to the Australian industry, the South African industry – owing to large tracks of suitable production areas still being available – is intensely focused on a horizontal expansion process and on the related organisational, technical and production issues supporting it. With large areas of young macadamia orchards in the process of coming into production, a tsunami of product is soon to hit existing processing and marketing facilities that are focused more internally than on market development and related activities. Because of the lack of proactive market development and demand/consumption enhancing strategies, this increased inflow of product volumes will progressively change the existing short supply and excess demand situation responsible for upward pressure on prices into an unnecessary over-supply situation which will place downward pressure on prices. The South African macadamia industry should expedite its progression from the introductory to the growth phase through the implementation of market development and consumption enhancing strategies, as the Australian macadamia industry and many other industries such as the South African avocado and soft citrus industries have done. Technical research should always enjoy priority and SAMAC and PMs should not neglect this aspect, and so they must supplement their research programmes, i.e. by examining health aspects and alternative consumption applications that would promote sustainable and noticeable increased consumption. The aim of these consumption-enhancing strategies must be to absorb increased product volumes as they emerge and thus retain the existing status quo of balanced supply and demand, resulting in the maintenance of favourable price levels.

6.5.5 Product development

With almost all macadamia nuts produced being sold as a relative unknown nut into the largely underdeveloped global snacking market at healthy profit margins, a huge potential for increased sale volumes of nuts still exists within the value-adding market, i.e. the candy, confectionery, and cereal/muesli markets. These markets are still largely underdeveloped because insufficient supply prevents the sustainable manufacturing and marketing of the mentioned value-added products. As production volumes increase and the snacking market
matures, value-adding markets must be progressively explored and serviced with the aim of creating confidence among value adders that sufficient product will be available to enable them to consistently manufacture and place their products on supermarket shelves.

6.5.6 Processing capacity

With the rapidly developing NIS market absorbing almost 50% of the annually produced crops, pressure on the demand for cracking capacity has reduced significantly. Due to this, PMs in general might underestimate/neglect their capital expenditure on cracking facility expansion and thus find themselves in trouble, should a sudden change in consumer preference or importing country policy changes force PMs to redirect NIS towards cracking plants. History has illustrated the point that a neglect in increasing cracking capacity can contribute to the build-up of large stocks of unprocessed nuts, resulting in the total or partial loss of product through quality deterioration. It is advisable for PMs to produce a balanced product spread of NIS and kernel and in the process provide for sufficient cracking plant capacity to cater for possible demand shifts in product format. Producers in turn should associate with PMs who have the ability and capacity to accommodate possible product format demand shifts.

6.5.7 Maximum profit margins at reduced volume sales versus increased volume sales at reduced profit margins

Global participants in the macadamia industry are, owing to existing market conditions, spoilt by healthy profit margins and in the future will have to accept a mind shift towards accepting reduced prices and profit margins attributable to increasing production volumes and the various market segments reaching saturation point. The mind shift that producers and PMs will have to make is the acceptance that low product volumes and related high prices will eventually have to make way for lower prices and increasing product volumes. Based on this, it is advisable for producers to realise that increased production unit sizes will be needed to maintain an economy of scale.
6.5.8 A unified South African macadamia industry

A cause for concern is the division in the PM industry born from the extreme levels of competition amongst PMs to secure their fair share of the available nut supply. The division in the industry at producer, as well at PM, level prevents the unification of the industry into a strategically focused and goal-orientated industry. All industry participants must take cognisance of the fact that the South African macadamia industry is, measured on a production volume basis a global leader, fully integrated into the global industry and that it has a prominent leadership role to play in all aspects of production and marketing. It is therefore advisable that all South African industry participants should focus on the long-term nature and scope of the crop and the industry, and so approach their involvement in, and the development of, the industry with a long-term view of unity, sustainability and reputability. A unified global industry leader would also provide critical mass with regard to determining the direction of global industry development.

6.6 Limitations of the study

The biggest limitation of this study was the limited availability of time series data which effectively prevented the application of the superior Johansen and Gregory Hansen cointegration tests, from which superior inferences and conclusions could have been made.

Due to the early developmental stage of the macadamia industry and resulting time-series data constraints, it is strongly recommended that the same price transmission study be repeated in five or six years’ time when sufficient time-series data has emerged, which would allow for the application of, and drawing inferences from, more advanced econometric model outputs.


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Zachariasse, V. and Bunte, F., 2003. *How are farmers faring in the changing balance of power along the food supply chain?*. The Hague, s.n.
ANNEXURE A: South African macadamia industry specific processes and terminology

A.1 Introduction

Two alternative quality separation processes namely a wet separation process (WSP) and dry separation process (DSP) exists within the South African macadamia processing industry.

Figure A.1 shows the macadamia process flow from the farm through the processing factory to the final packaged product ready for shipping to the value adders, wholesalers and retailers. It also shows a factory using both a specific gravity 1.02 (SG 1.02) and a specific gravity 1.00 (SG 1.00) saline bath to separate true first and second grade macadamia kernel.

In a processing plant using a single wet separation process (WSP) the process flow in Figure B.1 would exclude the second SG 1.00 saline bath. The mixed first and second grade nuts would remain as a single grade with only the removal of any USK through hand sorting (Lee et al., 2011).

A.2 Wet separation and dry separation processes

Owing to the fact that there are both wet separation processes (WSP) and dry separation processes (DSP) in use in South Africa, not all the terms apply equally in all processing facilities. For example, the terms “Floaters” and “Sinkers” have no application in a DSP facility. Even in the factories employing the WSP, it needs to be clearly understood that certain compromises have been incorporated into their design and operation, for practical reasons, which deviate from the fundamental science upon which water separation is based (Lee, Joubert, Tait, Schreuder and Hobson, 2011).

Mature macadamia nuts contain up to 75 % oil by weight, which is the highest oil content of any edible nut (Mason and McConachie, 1994). The oil content of macadamia kernels is the single most significant factor that determines its roasting and thus eating quality. Macadamia kernel is graded into grades of roasting/eating quality based on the amount of oil each kernel
contains. Grading processes relating to oil content of nuts have primarily been based on differences is specific gravity (SG). Scientific studies have determined that a strong correlation exists between the SG of nut kernels and the amount of oil that they contain. Research also shows a relationship between SG of raw kernel and the eating quality of roasted kernels. This kernel to oil content relation thus justifies the SG system as an index of kernel quality (Mason and McConachie, 1994).

Macadamia kernel which floats in tap water, specific gravity (SG) 1.000 to 1.012, contains 72% or more oil. Further experimentation has found linear correlations between SG and oil content of raw kernel, and between SG and flavour, texture and general acceptability of roasted kernel (Mason and Wills 1983). This led Mason and Wills to define the following grades on the basis of SG of the raw kernel:

First grade: Kernel floating in water with a SG < 1.00 can be classified as number 1 kernel

Second grade: Kernel floating in water with a SG between 1.00 – 1.02 can be classified as number 2 kernel.

Third or reject grade: Kernel only floating in water with a SG > 1.02 or otherwise stated, kernel sinking in water with a SG < 1.02 can be classified as Number 3 kernel (reject).

Mason and Wills also found that kernels within the SG range 0.97 to 1.00 produced a high quality roasted product, which was highly acceptable to the panel of experienced tasters. Kernels within SG range 1.00 – 1.02 were of lower eating quality, but were still given an acceptance rating of 50% by the panel. Kernels with SG > 1.02 were of poor eating quality and should not be accepted for processing (roasting, etc.) (Mason and Wills 1983).

The most South African WSP presently in use do not differentiate between the first and second grades as defined by Mason and Wills (1983). The general WSP in use separate a mixture of first and second grade kernel by passing the kernel and shell after cracking and initial physical removal of large shell pieces, through a bath filled with a brine solution of SG 1.02. The third or reject grade (SG < 1.02) kernel sinks in this solution, together with the shell pieces, while the clean first and second grade kernel floats and is then removed from the separation bath (Lee et al., 2011). Only two of the 17 South African macadamia processing
facilities separate true first grade kernels. This is done by first passing the kernel/shell product through an SG 1.02 water bath in which first and second grade kernel floats and shell and 3rd grade kernel sinks. The first and second grade floaters are then passed through a second SG 1.00 water separation bath in which first grade kernel floats and second grade kernel sinks. This is in line with the original concept of the wet separation technique (Lee et al., 2011). No dry processing facility, whether it is in South Africa, Australia or Hawaii is capable of producing a first grade kernel product in terms of Mason and Wills’ (1983) definition (Lee et al., 2011).
Figure A. 1: Diagrammatic representation of the original WSP

Source: Adapted from SAMAC Quality Assurance Handbook
A.3 Industry specific terminology

A.3.1 Nut-in-husk (NIH)

The term used to describe freshly harvested nuts before they are de-husked. No kernel moisture content (MC) is assumed. The kernel MC of freshly harvested nuts varies from 12 % to 25 % depending on prevailing climatic conditions and the harvesting interval (Lee et al., 2011).

A.3.2 Nut-in-shell (NIS)

A generic term used to describe any macadamia nuts still in the shell at any time after dehusking to cracking or to point of sale as NIS. If a MC is assumed or stipulated, it should be made clear as to whether this MC% applies to the kernel, or to the kernel and shell, i.e., the Nut-in-Shell as a whole (Lee et al., 2011).

A.3.3. Wet-in-shell (WIS)

A term used to describe any NIS from de-husking to delivery at the processor (no MC assumed or stipulated) (Lee et al., 2011).

A.3.4 Dry-in-shell (DIS)

A term used to describe dry NIS at the weighing point in the processing facility immediately before cracking. A standard kernel moisture content of 1.5 % is stipulated when using this term. Payment to growers, or the cracking charge to growers, is calculated on the basis of the weight of DIS nuts at 1.5 % kernel moisture. The conversion of weight at delivered WIS kernel moisture content, to weight at 1.5 % kernel moisture content is done using the following formula (Lee et al., 2011).

\[
\text{WEIGHT DIS @ 1.5 \% MC} = (\text{WEIGHT WIS @ Y\% MC}) \times \frac{(100-Y\%)}{(100-1.5 \%)}
\]
A.3.5 Sound kernel (SK)

Any raw macadamia kernel which meets the SAMAC minimum quality standards defined for South African Macadamias. Sound kernel must also meet the internationally accepted minimum quality standards when applicable (Lee et al., 2011).

A.3.6 Unsound Kernel (USK)

USK include any raw macadamia kernel which does not meet the SAMAC and international minimum quality standards for whatever reason. The reasons for not meeting minimum quality standards can include mould, rancidity, stinkbug and other insect damage, discolouration, immaturity, premature germination, impurities and microbial contamination, kernel meal as well as all kernel which sinks in a brine solution of specific gravity 1.02 (Lee et al., 2011).

A.3.7 Kernel meal

Very fine kernel particles (less than 2 mm in diameter) usually containing varying amounts of fine shell pieces. Unfit for human consumption unless completely free of shell pieces (Lee et al., 2011).

A.3.8 Sound kernel recovery (SKR)

The weight of sound kernel at 1.5 % moisture content expressed as a percentage of the DIS weight from which this sound kernel was recovered (Lee et al., 2011).

\[ \text{SKR} = \frac{\text{Weight sound kernel}}{\text{Weight DIS}} \times 100 \]

A.3.9 Unsound kernel recovery (USKR)

The weight of unsound kernel at 1.5 % moisture content expressed as a percentage of the Dry-in-shell weight from which this unsound kernel was recovered (Lee et al., 2011).

\[ \text{USKR} = \frac{\text{Weight unsound kernel}}{\text{Weight DIS}} \times 100 \]
A.3.10 Total kernel recovery (TKR)

The total weight of both sound and unsound kernel at 1.5 % moisture content expressed as a percentage of the Dry-in-shell weight from which this sound and unsound kernel was recovered (Lee et al., 2011).

\[ \text{TKR} = \frac{\text{Weight of sound and unsound kernel}}{\text{Weight DIS}} \times 100 \]

A.3.11 First or premium kernel

Kernel which floats in tap water of specific gravity 1.000 to 1.012, and which contains no defects (unsound kernel), in conformance with the SAMAC minimum quality standards (Lee et al., 2011).

A.3.12 Floaters

Include any kernel which floats in a saline solution of specified specific gravity (Lee et al., 2011).

A.3.13 Sinkers

Include any kernel which sinks in a saline solution of specified specific gravity (Lee et al., 2011).

A.3.14 Styles

A term used to describe the various macadamia products/mixes in terms of both the size of the individual kernels and the percentage of wholes, halves, pieces or chips. A typical style specification is represented in Table A.1.
A.4 Fitting the industry terminology and related calculation methodology into the South African macadamia quality separation process

The following example fit the defined industry terms into the processing sequence as shown in Figure A.1 and illustrates typical quantities of the various components from NIH to final product ready for shipping.

Assuming a farmer harvests 1000 kilograms of nut in husk (NIH). De-husking of the nuts will result in approximately 560 kg of WIS nuts (56 % of total NIH weight) and 440 kg of husk (44 % of total NIH weight). The husk will be composted and later used a mulching within the orchards. After de-husking the farmer will before delivery to a PM, cure the WIS nuts in on-farm curing facilities to between 10 % and 15 % MC.

On delivery of the de-husked nuts to the PM a 2.5 % random representative sample of the total WIS delivery weight will be drawn and analysed in order to determine the WIS MC % as well as sound kernel recovery rate (SKR %) and unsound kernel recovery rate (USKR %) of the consignment. This sample determined ratios and related factory processing costs will be used when determining the per kilogram producer price received by the farmer (Lee et al., 2011).
As a first step when determining the WIS MC % 250 grams of WIS nuts (A) will be placed in a curing oven and dried to a constant weight (B) i.e. 0 % MC. After curing the constant dried weight at 0 %, MC (B) is recorded as 212.5 grams. The WIS moisture content (Y) at time of delivery to the processing plant is then calculated as follows:

\[ WIS \ MC \% = \frac{A - B}{A} \times 100 \] (A.1)

\[ WIS \ MC \% = \frac{250 - 212.5}{250} \times 100 \]

\[ WIS \ MC \% = 15 \% \ (Y) \]

Based on the WIS MC % of 15 % as determined from the sample the 560 kg WIS nuts can be converted to a DIS at 1.5 % MC (C) weight by doing the following calculation.

\[ Weight \ DIS @ 1.5 \% MC = A \times \frac{100 - Y}{100 - 5} \] (A.2)

\[ Weight \ DIS @ 1.5 \% MC = 560 \times \]

\[ Weight \ DIS @ 1.5 \% MC = 560 \times \]

\[ Weight \ DIS @ 1.5 \% MC = 483.25 \ kg \]

As a second step, the kernel recovery rates of the delivered consignment need to be determined. A 500 gram sub sample is now taken from the initial sample and cured to a 1.5 % MC. The cured sample is then cracked and all kernel content removed as wholes, halves, pieces and fines are weighed and recorded as weight C. All recovered kernel is then placed in a clear container filled with a brine solution at ambient temperature and SG of 1.02. The kernel in the top half of the saline bath (floaters) and the kernel in the bottom half of the saline bath (sinkers) is then recovered separately and dried. The floaters and sinkers weights are respectively recorded as weights E and F. The floaters are then visually graded into two categories namely sound kernel (SK) and unsound kernel (USK). The SK component will be all kernel, free from any signs of immaturity, mould, discolouration, germination, insect damage, decomposition, rancidity and nut fines/dust. The SK component is weighed and recoded as weight G. The USK component made up from floater and sinker defects will be combined, weighed and recorded as weight J (Lee et al., 2011).
Figure A.3 is a schematic representation of the sequence of, and the different weight fractions recorded during, sample processing and to be used during kernel recovery rate calculations.

\[
\text{SKR} \% = \frac{\text{Weight of sound kernel @ 1.5\% MC (G)}}{\text{Weight of DIS @ 1.5\% MC (B)}} \times 100 \tag{A.3}
\]

\[
\text{SKR} \% = \left(\frac{G}{B}\right) \times 100
\]

\[
\text{USKR} \% = \frac{\text{Weight of unsound kernel @ 1.5\% MC (J)}}{\text{Weight of DIS @ 1.5\% MC (B)}} \times 100 \tag{A.4}
\]

\[
\text{USKR} \% = \left(\frac{J}{B}\right) \times 100
\]

Finally the SK component of the sample consisting of whole, halve, pieces and fine nuts are graded into the eight possible style categories as defined in Table A.1. The percentage that each style forms of the total sample SK component is then calculated. Each style has a
dedicated wholesale contract or spot price as negotiated between the processor/marketer (PM) and wholesaler/value adder (WVA) and serves as the gross producer price paid by PM to producers. Using the different style percentages as determined from the sample a combined gross average producer price per kilogram kernel is calculated and offered to the producer for the consignment delivered. The gross producer price can differ between consignments delivered due to varying style composition of the consignment after processing. One important factor contributing to different style compositions of consignments can be linked to the way different macadamia cultivars respond to processing.

The net producer price paid to producers by PM are, depending on the applicable PM model in operation, determined by all of, or a combination of the following factors. These factors include cost and incentive adjustments such as fixed and variable factory processing costs, NIS drying costs, penalties based and charged for USK content of consignments, statutory levies collected on behalf of SAMAC, storage costs, capital charges, shareholders payments, marketing, freight and administration costs as well as farmer incentives such as transport subsidies and delivery volume bonuses.